Fuji Electric
Innovating Energy Technology

# Instruction Manual

## High-performance, Vector Control Inverter

# FRENIC-VG

## ⚠CAUTION

Thank you for purchasing our high-performance, vector control FRENIC-VG series of inverters.

- This product is designed to drive a three-phase motor. Read through this instruction manual to become familiar with proper handling and correct use.
- Improper handling might result in incorrect operation, a short life, or even a failure of this product as well as the motor.
- Deliver this manual to the end user of this product. Keep this manual in a safe place until this product is discarded.
- For instructions on how to use an optional device, refer to the instruction and installation manuals for that optional device.
- This manual provides major functions of the FRENIC-VG. For details, refer to the FRENIC-VG User's Manual.

**Fuji Electric Co., Ltd.** **INR-SI47-1580b-E**

Copyright © 2013 Fuji Electric Co., Ltd.
All rights reserved.
No part of this publication may be reproduced or copied without prior written permission from Fuji Electric Systems Co., Ltd.

All products and company names mentioned in this manual are trademarks or registered trademarks of their respective holders.

The information contained herein is subject to change without prior notice for improvement.

# Preface

Thank you for purchasing our high-performance, vector control FRENIC-VG series of inverters. This product is designed to drive a three-phase motor.

Read through this instruction manual to become familiar with proper handling and correct use. Improper handling might result in incorrect operation, a short life, or even a failure of this product as well as the motor.

The related documents are subject to change without notice. Be sure to obtain the latest editions for use.

## Table of Contents


Preface ..... i

■ Safety precautions ..... v

Chapter 1 BEFORE USE ..... 1

1.1 Acceptance Inspection (Nameplates and type of inverter) ..... 1

1.2 External View and Terminal Blocks ..... 3

1.3 Precautions for Using Inverters ..... 4

1.3.1 Installation environment ..... 4

1.3.2 Storage environment ..... 6

[ 1 ] Temporary storage ..... 6

[ 2 ] Long-term storage ..... 6

1.3.3 Precautions for connection of peripheral equipment ..... 7

[ 1 ] Phase-advancing capacitors for power factor correction ..... 7

[ 2 ] Power supply lines (Application of a DC/AC reactor) ..... 7

[ 3 ] DC reactor (DCR) for correcting the inverter input power factor (for suppressing harmonics) ..... 7

[ 4 ] PWM converter for correcting the inverter input power factor ..... 7

[ 5 ] Molded case circuit breaker (MCCB) / Residual-Current-Operated Protective Device (RCD) / earth leakage circuit breaker (ELCB) ..... 8

[ 6 ] Magnetic contactor (MC) in the inverter input (primary) circuit ..... 10

[ 7 ] Magnetic contactor (MC) in the inverter output (secondary) circuit ..... 10

[ 8 ] Surge absorber/surge killer ..... 10

1.3.4 Noise reduction ..... 11

1.3.5 Leakage current ..... 11

1.3.6 Precautions in driving a permanent magnet synchronous motor (PMSM) ..... 11

Chapter 2 MOUNTING AND WIRING THE INVERTER ..... 12

2.1 Installing the Inverter ..... 12

2.2 Wiring ..... 14

2.2.1 Connection diagram ..... 14

2.2.2 Removing and mounting the front cover and the wiring guide ..... 16

2.2.3 Wiring precautions ..... 17

2.2.4 Wiring precautions ..... 19

2.2.5 Main circuit terminals ..... 21

[ 1 ] Screw specifications and recommended wire sizes ..... 21

[ 2 ] Main circuit terminals ..... 23

[ 3 ] Detailed functions of main circuit terminals ..... 25

2.2.6 Control circuit terminals (common to all inverter types) ..... 28

[ 1 ] Screw specifications and recommended wire sizes ..... 28

[ 2 ] Arrangement of terminals ..... 28

[ 3 ] Detailed functions of control circuit terminals ..... 29

[ 4 ] Wiring for control circuit terminals, for inverters of 75 kW (200 V class series) and those of 132-630 kW (400 V class series) ..... 35

2.2.7 Switching connectors ..... 36

2.2.8 Setting up the slide switches ..... 38

2.3 Mounting and Connecting a Keypad ..... 40

2.3.1 Parts required for connection ..... 40

2.3.2 Mounting procedure ..... 40

2.4 USB Connectivity ..... 44

Chapter 3 OPERATION USING THE KEYPAD ..... 45
3.1 Names and Functions of Keypad Components ..... 45
3.2 Programming Mode ..... 48
3.2.1 Setting the calendar clock -- Menu #12 "DATE/TIME" ..... 50
Chapter 4 TEST RUN PROCEDURE ..... 54
4.1 Checking Prior to Powering On ..... 55
4.2 Powering ON and Checking ..... 56
4.2.1 Checking the input state of PG (pulse generator) signals ..... 56
4.2.2 Mounting direction of a PG (pulse generator) and PG signals ..... 57
4.3 Selecting a Desired Motor Drive Control ..... 58
4.3.1 Vector control for IM with speed sensor ..... 58
4.3.2 Vector control for IM without speed sensor ..... 60
4.3.3 Vector control for PMSM with speed sensor and magnetic pole position sensor ..... 62
4.3.4 V/f control for IM ..... 65
4.4 Running the Inverter for Operation Check ..... 67
4.4.1 Test Run Procedure for Induction Motor (IM) ..... 67
4.4.2 Test Run Procedure for Permanent Magnet Synchronous Motor (PMSM) ..... 68
[ 1 ] Before proceeding with a test run ..... 68
[ 2 ] Preparation for a test run ..... 68
[ 3 ] Setting the magnetic pole position sensor offset value ..... 69
(1) Case where the magnetic pole position offset value is indicated on the label that came with the motor. ..... 69
(2) Case where the automatically adjust magnetic pole position offset value ..... 70
(3) Case where the manually adjust magnetic pole position offset value ..... 72
[ 3 ] Test run ..... 73
[ 4 ] Troubleshooting for motor abnormality ..... 73
4.5 Selecting a Speed Command Source ..... 74
4.5.1 Setting up a speed command from the keypad ..... 74
4.5.2 Setting up a speed command with an external potentiometer ..... 74
4.6 Selecting a Run Command Source ..... 75
4.6.1 Setting up a run command from the keypad ..... 75
4.6.2 Setting up a run command with digital input signals (terminals [FWD] and [REV]) ..... 75
Chapter 5 FUNCTION CODES ..... 76
5.1 Function Code Groups and Function Codes ..... 76
5.2 About the Contents of Column Headers in Function Code Tables ..... 77
5.3 Function Code Tables ..... 78
5.3.1 F codes (Fundamental Functions) ..... 78
5.3.2 E codes (Extension Terminal Functions) ..... 83
5.3.3 C codes (Control Functions) ..... 90
5.3.4 P codes (Motor Parameter Functions M1) ..... 92
5.3.5 H codes (High Performance Functions) ..... 94
5.3.6 A codes (Alternative Motor Parameter Functions M2/M3) ..... 101
5.3.7 o codes (Option Functions) ..... 101
5.3.8 L codes (Lift Functions) ..... 101
5.3.9 SF codes (Safety Functions) ..... 101
Chapter 6 TROUBLESHOOTING ..... 102
6.1 Protective Functions ..... 102
6.2 Before Proceeding with Troubleshooting ..... 103
6.3 If an alarm code appears on the LED monitor ..... 104
6.3.1 List of alarm codes ..... 104
6.3.2 Possible causes of alarms, checks and measures ..... 110
[ 7 ] ECF Functional safety circuit fault ..... 110
[ 27 ] OC Overcurrent ..... 110
[ 28 ] OH1 Heat sink overheat ..... 111
[ 29 ] OH2 External alarm ..... 112
[ 35 ] OLU Inverter overload ..... 112
[ 38 ] OU Overvoltage ..... 113

6.4 If the "Light Alarm" Indication (L -AL) Appears on the LED Monitor ..... 114
6.5 If Neither an Alarm Code Nor "Light Alarm" Indication (L -AL) Appears on the LED Monitor ..... 114
6.5.1 Abnormal motor operation ..... 114
[ 1 ] The motor does not rotate. ..... 114
[ 2 ] The motor rotates, but the speed does not change. ..... 116
[ 3 ] The motor runs in the opposite direction to the command. ..... 117
[ 4 ] Speed fluctuation or current oscillation (e.g., hunting) occurs during running at constant speed. ..... 117
[ 5 ] Grating sound is heard from the motor or the motor sound fluctuates. ..... 118
[ 6 ] The motor does not accelerate or decelerate within the specified time. ..... 118
[ 7 ] The motor does not restart even after the power recovers from a momentary power failure. ..... 119
[ 8 ] The motor abnormally heats up. ..... 119
[ 9 ] The motor does not run as expected. ..... 120
[ 10 ] When the motor accelerates or decelerates, the speed is not stable. ..... 120
[ 11 ] The motor stalls during acceleration. ..... 120
[ 12 ] When the T-Link communications option is in use, neither a run command nor a speed command takes effect ..... 121
[ 13 ] When the SX-bus communications option is in use, neither a run command nor a speed command takes effect ..... 121
[ 14 ] When the CC-Link communications option is in use, neither a run command nor a speed command takes effect ..... 121
[ 15 ] _ _ _ _ (under bar) appears. ..... 122
6.5.2 Problems with inverter settings ..... 122
[ 1 ] Nothing appears on the monitors. ..... 122
[ 2 ] The desired function code does not appear. ..... 122
[ 3 ] Data of function codes cannot be changed from the keypad. ..... 123
[ 4 ] Data of function codes cannot be changed via the communications link. ..... 123
Chapter 7 MAINTENANCE AND INSPECTION ..... 124
7.1 Inspection Interval ..... 124
7.2 Daily Inspection ..... 124
7.3 Periodic Inspection ..... 125
[ 1 ] Periodic inspection 1--Before the inverter is powered ON or after it stops running ..... 125
[ 2 ] Periodical inspection 2--When the inverter is ON or it is running. ..... 126
[ 3 ] Checking the functional safety circuit ..... 126
7.4 List of Periodic Replacement Parts ..... 127
7.4.1 Judgment on service life ..... 127
[ 1 ] Measurement of discharging time of the DC link bus capacitor ..... 128
[ 2 ] ON-time counting of DC link bus capacitor ..... 128
7.4.2 Battery ..... 130
[ 1 ] Outline ..... 130
[ 2 ] Loading the battery ..... 131
[ 3 ] About marine or air transport of a lithium-metal battery ..... 133
7.5 Measurement of Electrical Amounts in Main Circuit ..... 134
7.6 Insulation Test ..... 135
7.7 Inquiries about Product and Guarantee ..... 136
7.7.1 When making an inquiry ..... 136
7.7.2 Product warranty ..... 136
[ 1 ] Free of charge warranty period and warranty range ..... 136
[ 2 ] Exclusion of liability for loss of opportunity, etc. ..... 137
[ 3 ] Repair period after production stop, spare parts supply period (holding period) ..... 137
[ 4 ] Transfer rights ..... 137
[ 5 ] Service contents ..... 137
[ 6 ] Applicable scope of service ..... 137

Chapter 8 CONFORMITY WITH STANDARDS ..... 138
8.1 Compliance with European Standards ( CE ) ..... 138
8.1.1 Compliance with EMC standards ..... 138
8.1.2 Harmonic component regulation in the EU ..... 141
8.1.3 Compliance with the low voltage directive in the EU ..... 141
8.2 Compliance with UL Standards and Canadian Standards (cUL certification)) ( c UL us LISTED ) ..... 147
8.3 Compliance with the Radio Waves Act (South Korea) ( KC ) ..... 151
8.4 Compliance with Functional Safety Standard ..... 152
8.4.1 General ..... 152
8.4.2 Notes for compliance to Functional Safety Standard ..... 153
8.4.3 Functional safety performance ..... 154
8.4.4 Inverter output state when Safe Torque Off (STO) is activated ..... 155
8.4.5 ECF alarm (caused by logic discrepancy) and inverter output state ..... 156
8.4.6 Prevention of restarting ..... 157

## ■ Safety precautions

Read this manual thoroughly before proceeding with installation, connections (wiring), operation, or maintenance and inspection. Ensure you have sound knowledge of the device and familiarize yourself with all safety information and precautions before proceeding to operate the inverter.

Safety precautions are classified into the following two categories in this manual.

| | |
|---|---|
| ⚠WARNING | Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in death or serious bodily injuries. |
| ⚠CAUTION | Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in minor or light bodily injuries and/or substantial property damage. |

Failure to heed the information contained under the CAUTION title can also result in serious consequences. These safety precautions are of utmost importance and must be observed at all times.

### Application

#### ⚠WARNING

- The FRENIC-VG is designed to drive a three-phase motor. Do not use it for single-phase motors or for other purposes.

  **Fire or an accident could occur.**

- The FRENIC-VG may not be used for a life-support system or other purposes directly related to the human safety.
- Though the FRENIC-VG is manufactured under strict quality control, install safety devices for applications where serious accidents or property damages are foreseen in relation to the failure of it.

  **An accident could occur.**

### Installation

#### ⚠WARNING

- Install the inverter on a base made of metal or other non-flammable material.

  **Otherwise, a fire could occur.**

- Do not place flammable object nearby.

  **Doing so could cause fire.**

- Inverters with a capacity of 30 kW or above, whose protective structure is IP00, involve a possibility that a human body may touch the live conductors of the main circuit terminal block. Inverters to which an optional DC reactor is connected also involve the same. Install such inverters in an inaccessible place.

  **Otherwise, electric shock or injuries could occur.**

#### ⚠CAUTION

- Do not support the inverter by its front cover during transportation.

  **Doing so could cause a drop of the inverter and injuries.**

- Prevent lint, paper fibers, sawdust, dust, metallic chips, or other foreign materials from getting into the inverter or from accumulating on the heat sink.
- When changing the positions of the top and bottom mounting bases, use only the specified screws.

  **Otherwise, a fire or an accident might result.**

- Do not install or operate an inverter that is damaged or lacking parts.

  **Doing so could cause fire, an accident or injuries.**

### Wiring

## ⚠WARNING

- If no zero-phase current (earth leakage current) detective device such as a ground-fault relay is installed in the upstream power supply line in order to avoid the entire power supply system's shutdown undesirable to factory operation, install a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) individually to inverters to break the individual inverter power supply lines only.

  **Otherwise, a fire could occur.**

- When wiring the inverter to the power source, insert a recommended molded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) in the path of each pair of power lines to inverters. Use the recommended devices within the recommended current capacity.
- Use wires in the specified size.
- Tighten terminals with specified torque.

  **Otherwise, a fire could occur.**

- When there is more than one combination of an inverter and motor, do not use a multicore cable for the purpose of handling their wirings together.
- Do not connect a surge killer to the inverter's output (secondary) circuit.

  **Doing so could cause a fire.**

- Be sure to connect an optional DC reactor (DCR) when the capacity of the power supply transformer exceeds 500 kVA and is 10 times or more the inverter rated capacity.

  **Otherwise, a fire could occur.**

- Ground the inverter in compliance with the national or local electric code.
- Be sure to ground the inverter's grounding terminals ⏚G.

  **Otherwise, an electric shock or a fire could occur.**

- Qualified electricians should carry out wiring.
- Be sure to perform wiring after turning the power OFF.

  **Otherwise, an electric shock could occur.**

- Be sure to perform wiring after installing the inverter unit.

  **Otherwise, an electric shock or injuries could occur.**

- Ensure that the number of input phases and the rated voltage of the product match the number of phases and the voltage of the AC power supply to which the product is to be connected.

  **Otherwise, a fire or an accident could occur.**

- Do not connect the power supply wires to output terminals (U, V, and W).
- When connecting a DC braking resistor (DBR), never connect it to terminals other than terminals P(+) and DB.

  **Doing so could cause fire or an accident.**

- In general, sheaths of the control signal wires are not specifically designed to withstand a high voltage (i.e., reinforced insulation is not applied). Therefore, if a control signal wire comes into direct contact with a live conductor of the main circuit, the insulation of the sheath might break down, which would expose the signal wire to a high voltage of the main circuit. Make sure that the control signal wires will not come into contact with live conductors of the main circuit.

  **Doing so could cause an accident or an electric shock.**

## ⚠WARNING⚠

- Before changing the switches or touching the control circuit terminal symbol plate, **turn OFF the power and wait at least five minutes for inverters with a capacity of 22 kW or below, or at least ten minutes for inverters with a capacity of 30 kW or above**. Make sure that the LED monitor and charging lamp are turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below).

  **Otherwise, an electric shock could occur.**

## ⚠CAUTION

- The inverter, motor and wiring generate electric noise. Be careful about malfunction of the nearby sensors and devices. To prevent them from malfunctioning, implement noise control measures.

  **Otherwise an accident could occur.**

### Operation

## ⚠WARNING

- Be sure to mount the front cover before turning the power ON. Do not remove the cover when the inverter power is ON.
  **Otherwise, an electric shock could occur.**
- Do not operate switches with wet hands.
  **Doing so could cause electric shock.**
- If the auto-reset function has been selected, the inverter may automatically restart and drive the motor depending on the cause of tripping. Design the machinery or equipment so that human safety is ensured at the time of restarting.
  **Otherwise, an accident could occur.**
- If the stall prevention function (torque limiter) has been selected, the inverter may operate with acceleration/deceleration or speed different from the commanded ones. Design the machine so that safety is ensured even in such cases.
- The (STOP) key on the keypad is effective only when the keypad operation is enabled with function code F02 (= 0, 2 or 3). When the keypad operation is disabled, prepare an emergency stop switch separately for safe operations. Switching the run command source from keypad (local) to external equipment (remote) by turning ON the "Enable communications link" command ***LE*** disables the (STOP) key.
- If any of the protective functions have been activated, first remove the cause. Then, after checking that the all run commands are set to OFF, release the alarm. If the alarm is released while any run commands are set to ON, the inverter may supply the power to the motor, running the motor.
  **Otherwise, an accident could occur.**
- If you enable the "Restart mode after momentary power failure" (Function code F14 = 3 to 5), then the inverter automatically restarts running the motor when the power is recovered.
  Design the machinery or equipment so that human safety is ensured after restarting.
- If the user configures the function codes wrongly without completely understanding this Instruction Manual and the FRENIC-VG User's Manual, the motor may rotate with a torque or at a speed not permitted for the machine.
- The motor rotates when you start the auto-tuning. Check that it is not dangerous enough even when the motor is rotating.
  **An accident or injuries could occur.**
- Even if the inverter has interrupted power to the motor, if the voltage is applied to the main circuit input terminals L1/R, L2/S and L3/T, voltage may be output to inverter output terminals U, V, and W.
- Even if the motor is stopped due to DC braking or preliminary excitation, voltage is output to inverter output terminals U, V, and W.
  **An electric shock may occur.**
- The inverter can easily accept high-speed operation. When changing the speed setting, carefully check the specifications of motors or equipment beforehand.
  **Otherwise, injuries could occur.**

## ⚠CAUTION

- Do not touch the heat sink and braking resistor because they become very hot.
  **Doing so could cause burns.**
- The DC brake function of the inverter does not provide any holding mechanism.
  **Injuries could occur.**
- Ensure safety before modifying the function code settings.
  Run commands (e.g., "Run forward" ***FWD***), stop commands (e.g., "Coast to a stop" ***BX***), and speed change commands can be assigned to digital input terminals. Depending upon the assignment states of those terminals, modifying the function code setting may cause a sudden motor start or an abrupt change in speed.
- When the inverter is controlled with the digital input signals, switching run or speed command sources with the related terminal commands (e.g., ***SS1***, ***SS2***, ***SS4***, ***SS8***, ***N2/N1***, ***KP/PID***, ***IVS***, and ***LE***) may cause a sudden motor start or an abrupt change in speed.
  **An accident or injuries could occur.**

### Maintenance and inspection, and parts replacement

## ⚠WARNING⚠

- Before proceeding to the maintenance/inspection jobs, **turn OFF the power and wait at least five minutes for inverters with a capacity of 22 kW or below, or at least ten minutes for inverters with a capacity of 30 kW or above**. Make sure that the LED monitor and charging lamp are turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below).

  **Otherwise, an electric shock could occur.**

- Maintenance, inspection, and parts replacement should be made only by qualified persons.
- Take off the watch, rings and other metallic objects before starting work.
- Use insulated tools.

  **Otherwise, an electric shock or injuries could occur.**

- Never modify the inverter.

  **Doing so could cause an electric shock or injuries.**

### Disposal

## ⚠CAUTION

- Treat this product as an industrial waste when disposing of it.

  **Otherwise injuries could occur.**

- The battery used in this product is a so-called primary battery. When disposing of it, comply with local codes and regulations.

### Speed control mode

## ⚠CAUTION

- If the control parameters of the automatic speed regulator (ASR) are not appropriately configured under speed control, even turning the run command OFF may not decelerate the motor due to hunting caused by high gain setting. Accordingly, the inverter may not reach the stop conditions so that it may continue running.

  Even if the inverter starts deceleration, the detected speed deviates from the zero speed area before the zero speed control duration (F39) elapses due to hunting caused by high response in low speed operation. Accordingly, the inverter will not reach the stop conditions so that it enters the deceleration mode again and continues running.

  If any of the above problems occurs, adjust the ASR control parameters to appropriate values and use the speed mismatch alarm function in order to alarm-trip the inverter, switch the control parameters by speed, or judge the detection of a stop speed by commanded values when the actual speed deviates from the commanded one.

  **An accident or injuries could occur.**

### Torque control mode

## ⚠CAUTION

- When the motor is rotated by load-side torque exceeding the torque command under torque control, turning the run command OFF may not bring the stop conditions so that the inverter may continue running.

  To shut down the inverter output, switch from torque control to speed control and apply a decelerate-to-stop or coast-to-stop command.

  **An accident or injuries could occur.**

### General precautions

## ⚠CAUTION

Drawings in this manual may be illustrated without covers or safety shields for explanation of detail parts. Restore the covers and shields in the original state and observe the description in the manual before starting operation.

### Icons

The following icons are used throughout this manual.

This icon indicates information which, if not heeded, can result in the inverter not operating to full efficiency, as well as information concerning incorrect operations and settings which can result in accidents.

This icon indicates information that can prove handy when performing certain settings or operations.

This icon indicates a reference to more detailed information.

# Chapter 1 BEFORE USE

## 1.1 Acceptance Inspection (Nameplates and type of inverter)

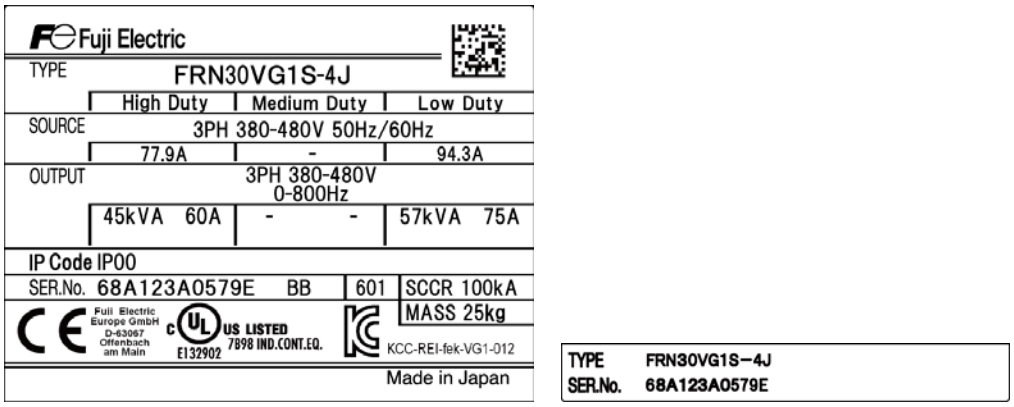
Unpack the package and check the following:

(1) An inverter and the following accessories are contained.

Accessories - DC reactor (DCR)
(for inverters of 75 kW or above and LD-mode inverters of 55 kW)
- Instruction manual (this document)
- CD-ROM (containing the FRENIC-VG User's Manual, FRENIC-VG Loader (free version), and FRENIC-VG Loader Instruction Manual)

(2) The inverter has not been damaged during transportation—there should be no dents or parts missing.

(3) The inverter is the type you ordered. You can check the type and specifications on the main and sub nameplates. (The main and sub nameplates are attached to the inverter as shown in Figure 1.2-1.) For inverters of 30 kW or above, the mass is printed on the main nameplate.




(a) Main Nameplate (b) Sub Nameplate

Figure 1.1-1 Nameplates

TYPE: Type of inverter

**FRN 5.5 □ VG1□-2□ □□**

| Code | Series name |
|---|---|
| FRN | FRENIC series |

| Code | Nominal applied motor |
|---|---|
| 0.75 | 0.75 kW |
| 1.5 | 1.5 kW |
| 2.2 | 2.2 kW |
| ⋮ | ⋮ |
| 800 | 800 kW |

| Code | Structure |
|---|---|
| None | Unit type |
| S | Standard stack type |
| B | Phase-specific stack type |

Special type

| Code | Shipping destination/ Instruction manual language |
|---|---|
| J | Japan/Japanese |
| E | EU/ English |
| C | China/Chinese |
| Z | Special type |

| Code | Power supply voltage |
|---|---|
| 2 | Three-phase 200 V |
| 4 | Three-phase 400 V |

| Code | Enclosure |
|---|---|
| S | Basic type |

| Code | Development code |
|---|---|
| 1 | 1 series |

| Code | Applicable area |
|---|---|
| VG | High performance, vector control |

Note In this manual, inverter types are denoted as "FRN_ _ _VG1□-2□/4□."

The FRENIC-VG is available in two or three drive modes depending upon the inverter capacity: High Duty (HD) and Low Duty (LD) modes or High Duty (HD), Medium Duty (MD) and Low Duty (LD) modes. One of these modes should be selected to match the load property of your system. Specifications in each mode are printed on the main nameplate.

High Duty : HD mode designed for heavy duty load applications.
Overload capability: 150% for 1 min, 200% for 3 s. Continuous ratings = Inverter ratings

Medium Duty : MD mode designed for medium duty load applications.
Overload capability: 150% for 1 min. Continuous ratings = One rank higher capacity of inverters

Low Duty : LD mode designed for light duty load applications.
Overload capability: 120% for 1 min. Continuous ratings = One rank or two ranks higher capacity of inverters

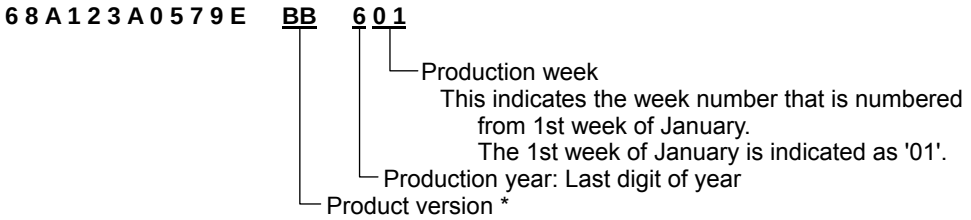
SOURCE : Number of input phases (three-phase: 3PH), input voltage, input frequency, input current

OUTPUT : Number of output phases, rated output voltage, output frequency range, rated output capacity, rated output current, and overload capability

SCCR : Short-circuit capacity

MASS : Mass of the inverter in kilogram (for 30 kW or above)

SER. No. : Product number




: Compliance with European Standards (See Chapter 8 Section 8.1)

: Compliance with UL Standards and Canadian Standards (cUL certification) (See Chapter 8 Section 8.2)

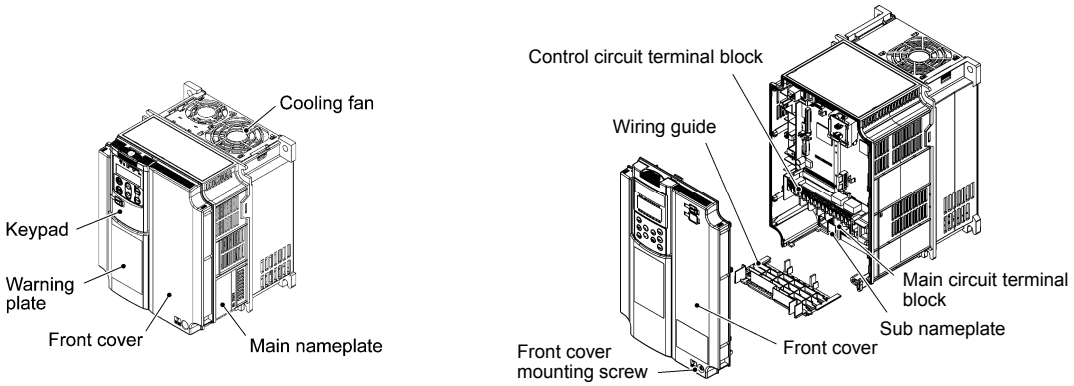
: Compliance with the Radio Waves Act (South Korea) (See Chapter 8 Section 8.3)

* Functional safety standards is supported on products other than "AA", "AB" product version.

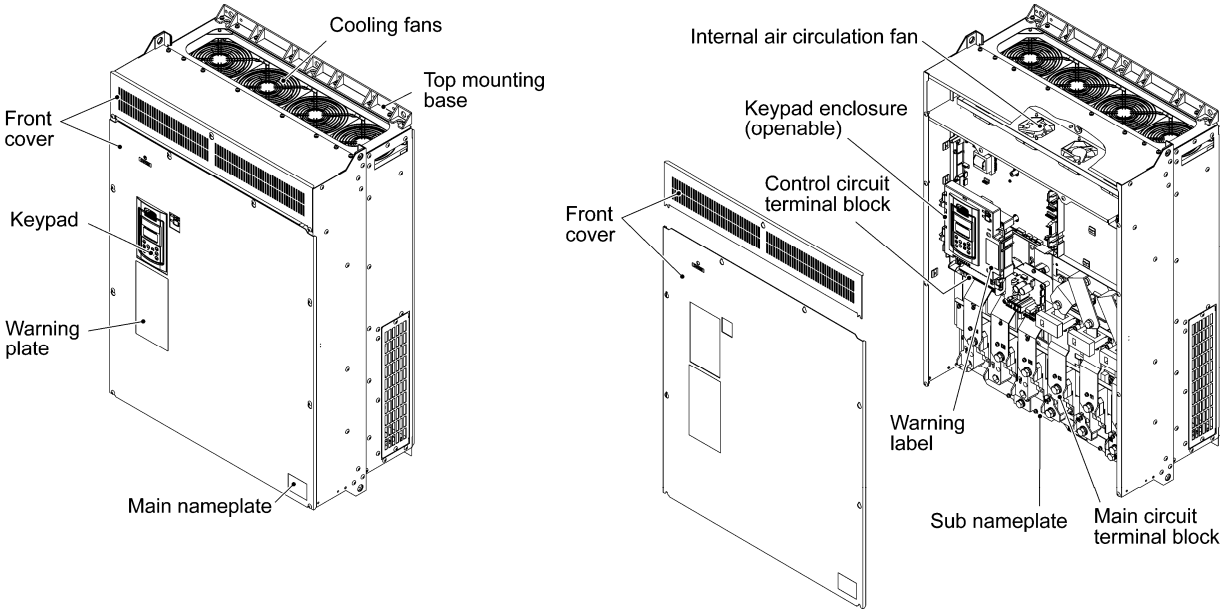
If you suspect the product is not working properly or if you have any questions about your product, contact your Fuji Electric representative.

## 1.2 External View and Terminal Blocks

(1) Outside and inside views




(a) FRN7.5VG1□-2□




(b) FRN220VG1□-4□

Figure 1.2-1 Outside and Inside Views of Inverters

(2) Warning plates and label

(a) FRN7.5VG1□-2□ (b) FRN220VG1□-4□

Figure 1.2-2 Warning Plates and Label

## 1.3 Precautions for Using Inverters

This section provides precautions in introducing inverters, e.g. precautions for installation environment, power supply lines, wiring, and connection to peripheral equipment. Be sure to observe those precautions.

### 1.3.1 Installation environment

Install the inverter in an environment that satisfies the requirements listed in Table 1.3-1.

Table 1.3-1 Environmental Requirements

<table>
<tr><th>Item</th><th colspan="4">Specifications</th></tr>
<tr><td>Site location</td><td colspan="4">Indoors</td></tr>
<tr><td>Surrounding temperature</td><td colspan="4">-10 to +50°C (Note 1)</td></tr>
<tr><td>Relative humidity</td><td colspan="4">5 to 95% (No condensation)</td></tr>
<tr><td>Atmosphere</td><td colspan="4">The inverter must not be exposed to dust, direct sunlight, corrosive gases, flammable gases, oil mist, vapor or water drops.<br>Pollution degree 2 (IEC60664-1) (Note 2)<br>The atmosphere can contain a small amount of salt. (0.01 mg/cm$^2$ or less per year)<br>The inverter must not be subjected to sudden changes in temperature that will cause condensation to form.</td></tr>
<tr><td>Altitude</td><td colspan="4">1,000 m max. (Note 3)</td></tr>
<tr><td>Atmospheric pressure</td><td colspan="4">86 to 106 kPa</td></tr>
<tr><td rowspan="2">Vibration</td><td colspan="2">55 kW or below (200 V class series)<br>75 kW or below (400 V class series)</td><td colspan="2">75 kW or above (200 V class series)<br>90 kW or above (400 V class series)</td></tr>
<tr><td>3 mm (Max. amplitude)<br>9.8 m/s$^2$<br>2 m/s$^2$<br>1 m/s$^2$</td><td>2 to less than 9 Hz<br>9 to less than 20 Hz<br>20 to less than 55 Hz<br>55 to less than 200 Hz</td><td>3 mm (Max. amplitude)<br>2 m/s$^2$<br>1 m/s$^2$</td><td>2 to less than 9 Hz<br>9 to less than 55 Hz<br>55 to less than 200 Hz</td></tr>
</table>

**(Note 1)** When inverters are mounted side-by-side without any clearance between them (22 kW or below), the surrounding temperature should be within the range from -10 to +40°C.

**(Note 2)** Do not install the inverter in an environment where it may be exposed to lint, cotton waste or moist dust or dirt which will clog the heat sink of the inverter. If the inverter is to be used in such an environment, install it in a dustproof panel of your system.

**(Note 3)** If you use the inverter in an altitude above 1000 m, you should apply an output current derating factor as listed in Table 2.1-2.

Table 1.3-2 Output Current Derating Factor in Relation to Altitude

| Altitude | Output current derating factor |
|---|---|
| 1000 m or lower | 1.00 |
| 1000 to 1500 m | 0.97 |
| 1500 to 2000 m | 0.95 |
| 2000 to 2500 m | 0.91 |
| 2500 to 3000 m | 0.88 |

Fuji Electric strongly recommends installing inverters in a panel for safety reasons, in particular, when installing the ones whose enclosure rating is IP00.

When installing the inverter in a place out of the specified environmental requirements, it is necessary to derate the inverter or consider the panel engineering design suitable for the special environment or the panel installation location. For details, refer to the Fuji Electric technical information "Engineering Design of Panels" or consult your Fuji Electric representative.

The special environments listed below require using the specially designed panel or considering the panel installation location.

| Environments | Possible problems | Sample measures | Applications |
|---|---|---|---|
| Highly concentrated sulfidizing gas or other corrosive gases | Corrosive gases cause parts inside the inverter to corrode, resulting in an inverter malfunction. | Any of the following measures may be necessary.<br>- Mount the inverter in a sealed panel with IP6X or air-purge mechanism.<br>- Place the panel in a room free from influence of the gases. | Paper manufacturing, sewage disposal, sludge treatment, tire manufacturing, gypsum manufacturing, metal processing, and a particular process in textile factories. |
| A lot of conductive dust or foreign material (e.g., metal powders or shavings, carbon fibers, or carbon dust) | Entry of conductive dust into the inverter causes a short circuit. | Any of the following measures may be necessary.<br>- Mount the inverter in a sealed panel.<br>- Place the panel in a room free from influence of the conductive dust. | Wiredrawing machines, metal processing, extruding machines, printing presses, combustors, and industrial waste treatment. |
| A lot of fibrous or paper dust | Fibrous or paper dust accumulated on the heat sink lowers the cooing effect.<br>Entry of dust into the inverter causes the electronic circuitry to malfunction. | Any of the following measures may be necessary.<br>- Mount the inverter in a sealed panel that shuts out dust.<br>- Ensure a maintenance space for periodical cleaning of the heat sink in panel engineering design.<br>- Employ external cooling when mounting the inverter in a panel for easy maintenance and perform periodical maintenance. | Textile manufacturing and paper manufacturing. |
| High humidity or dew condensation | In an environment where a humidifier is used or where the air conditioner is not equipped with a dehumidifier, high humidity or dew condensation results, which causes a short-circuiting or malfunction of electronic circuitry inside the inverter. | - Put a heating module such as a space heater in the panel. | Outdoor installation.<br>Film manufacturing line, pumps and food processing. |
| Vibration or shock exceeding the specified level | If a large vibration or shock exceeding the specified level is applied to the inverter, for example, due to a carrier running on seam joints of rails or blasting at a construction site, the inverter structure gets damaged. | - Insert shock-absorbing materials between the mounting base of the inverter and the panel for safe mounting. | Installation of an inverter panel on a carrier or self-propelled machine.<br>Ventilating fan at a construction site or a press machine. |
| Fumigation for export packaging | Halogen compounds such as methyl bromide used in fumigation corrodes some parts inside the inverter. | - When exporting an inverter built in a panel or equipment, pack them in a previously fumigated wooden crate.<br>- When packing an inverter alone for export, use a laminated veneer lumber (LVL). | Exporting. |

### 1.3.2 Storage environment

The storage environment in which the inverter should be stored after purchase differs from the installation environment. Store the inverter in an environment that satisfies the requirements listed below.

#### [ 1 ] Temporary storage

Table 1.3-3 Storage and Transport Environments

| Item | Specifications | |
|---|---|---|
| Storage temperature *1 | -25 to +70°C | Places not subjected to abrupt temperature changes or condensation or freezing |
| Relative humidity | 5 to 95% *2 | |
| Atmosphere | The inverter must not be exposed to dust, direct sunlight, corrosive or flammable gases, oil mist, vapor, water drops or vibration. The atmosphere must contain only a low level of salt. (0.01 mg/cm$^2$ or less per year) | |
| Atmospheric pressure | 86 to 106 kPa (during storage) | |
| | 70 to 106 kPa (during transportation) | |

***1** Assuming comparatively short time storage, e.g., during transportation or the like.

***2** Even if the humidity is within the specified requirements, avoid such places where the inverter will be subjected to sudden changes in temperature that will cause condensation or freezing.

Precautions for temporary storage

(1) Do not leave the inverter directly on the floor.

(2) If the environment does not satisfy the specified requirements listed in Table 1.3-3, wrap the inverter in an airtight vinyl sheet or the like for storage.

(3) If the inverter is to be stored in a high-humidity environment, put a drying agent (such as silica gel) in the airtight package described in (2) above.

#### [ 2 ] Long-term storage

The long-term storage method of the inverter varies largely according to the environment of the storage site. General storage methods are described below.

(1) The storage site must satisfy the requirements specified for temporary storage.

However, for storage exceeding three months, the surrounding temperature range should be within the range from -10 to 30°C. This is to prevent electrolytic capacitors in the inverter from deterioration.

(2) The package must be airtight to protect the inverter from moisture. Add a drying agent inside the package to maintain the relative humidity inside the package within 70%.

(3) If the inverter has been installed to the equipment or panel at construction sites where it may be subjected to humidity, dust or dirt, then temporarily remove the inverter and store it in the environment specified in Table 1.3-3.

Precautions for storage over 1 year

If the inverter has not been powered on for a long time, the property of the electrolytic capacitors may deteriorate. Power the inverters on once a year and keep the inverters powering on for 30 to 60 minutes. Do not connect the inverters to the load circuit (secondary side) or run the inverter.

### 1.3.3 Precautions for connection of peripheral equipment

#### [ 1 ] Phase-advancing capacitors for power factor correction

Do not mount a phase-advancing capacitor for power factor correction in the inverter's input (primary) or output (secondary) circuit. Mounting it in the input (primary) circuit takes no effect. To correct the inverter power factor, use an optional DC reactor (DCR). Mounting it in the output (secondary) circuit causes an overcurrent trip, disabling operation.

An overvoltage trip that occurs when the inverter is stopped or running with a light load is assumed to be due to surge current generated by open/close of phase-advancing capacitors in the power system. An optional DC/AC reactor (DCR/ACR) is recommended as a measure to be taken at the inverter side.

Input current to an inverter contains a harmonic component that may affect other motors and phase-advancing capacitors on the same power supply line. If the harmonic component causes any problems, connect a DCR/ACR to the inverter. In some cases, it is necessary to insert a reactor in series with the phase-advancing capacitors.

#### [ 2 ] Power supply lines (Application of a DC/AC reactor)

Use a DC reactor (DCR) when the capacity of the power supply transformer is 500 kVA or more and is 10 times or more the inverter rated capacity or when there are thyristor-driven loads. If no DCR is used, the percentage-reactance of the power supply decreases, and harmonic components and their peak levels increase. These factors may break rectifiers or capacitors in the converter section of the inverter, or decrease the capacitance of the capacitors.

If the input voltage unbalance rate is 2% to 3%, use an optional AC reactor (ACR).

$$\text{Voltage unbalance (\%)} = \frac{\text{Max. voltage (V)} - \text{Min. voltage (V)}}{\text{Three - phase average voltage (V)}} \times 67 \text{ (IEC/EN61800 - 3)}$$

#### [ 3 ] DC reactor (DCR) for correcting the inverter input power factor (for suppressing harmonics)

To correct the inverter input power factor (to suppress harmonics), use a DCR. Using a DCR increases the reactance of inverter's power source so as to decrease harmonic components on the power source lines and correct the power factor of the inverter.

| DCR models | Input power factor | Remarks |
|---|---|---|
| DCR2/4-□□/□□A/□□B | Approx. 90% to 95% | The last letter identifies the capacitance.<br>These DCR models comply with "Standard Specifications for Public Building Construction" (Electric Equipment, 2010 version) supervised by the Ministry of Land, Infrastructure, Transport and Tourism.<br>(The input power factor is 94% or above when the power factor of the fundamental harmonic is assumed as "1" according to the 2010 version.) |
| DCR2/4-□□C | Approx. 86% to 90% | Exclusively designed for nominal applied motor of 37 kW or above. |

Note
- Select a DCR matching not the inverter capacity but the nominal applied motor. Applicable reactors differ depending upon the selected HD, MD, or LD mode even on the same type of inverters.
- Inverters of 75 kW or above and LD-mode inverters of 55 kW are provided together with a DCR as standard. Be sure to connect the DCR to the inverter.

#### [ 4 ] PWM converter for correcting the inverter input power factor

Using a PWM converter (High power-factor, regenerative PWM converter, RHC series) corrects the inverter power factor up to nearly "1." When combining an inverter with a PWM converter, disable the main power down detection by setting the function code H76 to "0" (default). If the main power down detection is enabled (H76 = 1), the inverter interprets the main power as being shut down, ignoring an entry of a run command.

## [ 5 ] Molded case circuit breaker (MCCB) / Residual-Current-Operated Protective Device (RCD) / earth leakage circuit breaker (ELCB)

Install a recommended MCCB or RCD/ELCB (with overcurrent protection) in the primary circuit of the inverter to protect the wiring. Since using an MCCB or RCD/ELCB with a lager capacity than recommended ones breaks the protective coordination of the power supply system, be sure to select recommended ones. Also select ones with short-circuit breaking capacity suitable for the power source impedance.

Molded Case Circuit Breaker (MCCB) and
Residual-Current-Operated Protective Device (RCD)/Earth Leakage Circuit Breaker (ELCB)

| Power supply voltage | Nominal applied motor (kW) | Inverter type | HD/ MD/ LD mode | Rated current of MCCB and RCD/ELCB (A) | |
|---|---|---|---|---|---|
| | | | | w/ DCR | w/o DCR |
| Three-phase 200 V | 0.75 | FRN0.75VG1□-2□ | HD | 5 | 10 |
| | 1.5 | FRN1.5VG1□-2□ | HD | 10 | 15 |
| | 2.2 | FRN2.2VG1□-2□ | HD | | 20 |
| | 3.7 | FRN3.7VG1□-2□ | HD | 20 | 30 |
| | 5.5 | FRN5.5VG1□-2□ | HD | 30 | 50 |
| | 7.5 | FRN7.5VG1□-2□ | HD | 40 | 75 |
| | 11 | FRN11VG1□-2□ | HD | 50 | 100 |
| | 15 | FRN15VG1□-2□ | HD | 75 | 125 |
| | 18.5 | FRN18.5VG1□-2□ | HD | 100 | 150 |
| | 22 | FRN22VG1□-2□ | HD | | 175 |
| | 30 | FRN30VG1□-2□ | HD | 150 | 200 |
| | 37 | | LD | 175 | 250 |
| | | FRN37VG1□-2□ | HD | | |
| | 45 | | LD | 200 | 300 |
| | | FRN45VG1□-2□ | HD | | |
| | 55 | | LD | 250 | 350 |
| | | FRN55VG1□-2□ | HD | | |
| | 75 | | LD | 350 | - |
| | | FRN75VG1□-2□ | HD | | |
| | 90 | | LD | 400 | |
| | | FRN90VG1□-2□ | HD | | |
| | 110 | | LD | 350 | |

Molded Case Circuit Breaker (MCCB) and
Residual-Current-Operated Protective Device (RCD)/Earth Leakage Circuit Breaker (ELCB) (continued)

| Power supply voltage | Nominal applied motor (kW) | Inverter type | HD/ MD/ LD mode | Rated current of MCCB and RCD/ELCB (A) | |
|---|---|---|---|---|---|
| | | | | w/ DCR | w/o DCR |
| Three-phase 400 V | 3.7 | FRN3.7VG1□-4□ | HD | 10 | 20 |
| | 5.5 | FRN5.5VG1□-4□ | HD | 15 | 30 |
| | 7.5 | FRN7.5VG1□-4□ | HD | 20 | 40 |
| | 11 | FRN11VG1□-4□ | HD | 30 | 50 |
| | 15 | FRN15VG1□-4□ | HD | 40 | 60 |
| | 18.5 | FRN18.5VG1□-4□ | HD | | 75 |
| | 22 | FRN22VG1□-4□ | HD | 50 | 100 |
| | 30 | FRN30VG1□-4□ | HD | 75 | 125 |
| | 37 | | LD | 100 | |
| | | FRN37VG1□-4□ | HD | | |
| | 45 | | LD | | 150 |
| | | FRN45VG1□-4□ | HD | | |
| | 55 | | LD | 125 | 200 |
| | | FRN55VG1□-4□ | HD | | |
| | 75 | | LD | 175 | - |
| | | FRN75VG1□-4□ | HD | | |
| | 90 | | LD | 200 | |
| | | FRN90VG1□-4□ | HD | | |
| | 110 | | MD/LD | 250 | |
| | | FRN110VG1□-4□ | HD | | |
| | 132 | | MD/LD | 300 | |
| | | FRN132VG1□-4□ | HD | | |
| | 160 | | MD/LD | 350 | |
| | | FRN160VG1□-4□ | HD | | |
| | 200 | | MD/LD | 500 | |
| | | FRN200VG1□-4□ | HD | | |
| | 220 | | MD/LD | | |
| | | FRN220VG1□-4□ | HD | | |
| | 250 | | MD | 600 | |
| | 280 | | L D | | |
| | | FRN280VG1□-4□ | HD | | |
| | 315 | | MD | 800 | |
| | | FRN315VG1□-4□ | HD | | |
| | 355 | FRN280VG1□-4□ | LD | | |
| | | FRN315VG1□-4□ | MD | | |
| | | FRN355VG1□-4□ | HD | | |
| | 400 | FRN315VG1□-4□ | LD | 1200 | |
| | | FRN355VG1□-4□ | MD | | |
| | | FRN400VG1□-4□ | HD | | |
| | 450 | FRN355VG1□-4□ | LD | | |
| | | FRN400VG1□-4□ | MD | | |
| | 500 | | LD | | |
| | | FRN500VG1□-4□ | HD | | |
| | 630 | | LD | 1400 | |
| | | FRN630VG1□-4□ | HD | | |
| | 710 | | LD | 1600 | |

## ⚠WARNING

If no zero-phase current (earth leakage current) detective device such as a ground-fault relay is installed in the upstream power supply line in order to avoid the entire power supply system's shutdown undesirable to factory operation, install a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) individually to inverters to break the individual inverter power supply lines only.

**Otherwise, a fire could occur.**

### [ 6 ] Magnetic contactor (MC) in the inverter input (primary) circuit

Avoid frequent ON/OFF operation of the magnetic contactor (MC) in the input circuit; otherwise, the inverter failure may result. If frequent start/stop of the motor is required, use ***FWD***/***REV*** terminal signals or the RUN / STOP keys on the inverter's keypad.

The frequency of the MC's ON/OFF should not be more than once per 30 minutes. To assure 10-year or longer service life of the inverter, it should not be more than once per hour.

Tip

- From the system's safety point of view, it is recommended to employ such a sequence that shuts down the magnetic contactor (MC) in the inverter input circuit with an alarm output signal ***ALM*** issued on inverter's programmable output terminals. The sequence minimizes the secondary damage even if the inverter breaks.

  When the sequence is employed, connecting the MC's primary power line to the inverter's auxiliary control power input makes it possible to monitor the inverter's alarm status on the keypad.

- The breakdown of a braking unit or misconnection of an external braking resistor may trigger that of the inverter's internal parts (e.g., charging resistor). To avoid such a breakdown linkage, introduce an MC and configure a sequence that shuts down the MC if a DC link voltage establishment signal is not issued within three seconds after the MC is switched on.

  For the braking transistor built-in type of inverters, assign a transistor error output signal ***DBAL*** on inverter's programmable output terminals to switch off the MC in the input circuit.

### [ 7 ] Magnetic contactor (MC) in the inverter output (secondary) circuit

If a magnetic contactor (MC) is inserted in the inverter's output (secondary) circuit for switching the motor to a commercial power or for any other purposes, it should be switched on and off when both the inverter and motor are completely stopped. This prevents the contact point from getting rough due to a switching arc of the MC. The MC should not be equipped with any main circuit surge killer.

Applying a commercial power to the inverter's output circuit breaks the inverter. To avoid it, interlock the MC on the motor's commercial power line with the one in the inverter output circuit so that they are not switched ON at the same time.

### [ 8 ] Surge absorber/surge killer

Do not install any surge absorber or surge killer in the inverter's output (secondary) lines.

### 1.3.4 Noise reduction

If noise generated from the inverter affects other devices, or that generated from peripheral equipment causes the inverter to malfunction, follow the basic measures outlined below.

(1) If noise generated from the inverter affects the other devices through power wires or grounding wires:
- Isolate the grounding terminals of the inverter from those of the other devices.
- Connect a noise filter to the inverter power wires.
- Isolate the power system of the other devices from that of the inverter with an insulated transformer.
- Decrease the inverter's carrier frequency (F26). (See **Note** below.)

(2) If induction or radio noise generated from the inverter affects other devices:
- Isolate the main circuit wires from the control circuit wires and other device wires.
- Put the main circuit wires through a metal conduit pipe, and connect the pipe to the ground near the inverter.
- Install the inverter into the metal panel and connect the whole panel to the ground.
- Connect a noise filter to the inverter's power wires.
- Decrease the inverter's carrier frequency (F26). (See **Note** below.)

(3) When implementing measures against noise generated from peripheral equipment:
- For inverter's control signal wires, use twisted or shielded-twisted wires. When using shielded-twisted wires, connect the shield of the shielded wires to the common terminals of the control circuit.
- Connect a surge absorber in parallel with magnetic contactor's coils or other solenoids (if any).

**Note** Running a permanent magnet synchronous motor (PMSM) at a low carrier frequency may heat the permanent magnet due to the output current harmonics, resulting in demagnetization. When decreasing the carrier frequency setting, be sure to check the allowable carrier frequency of the motor.

### 1.3.5 Leakage current

A high frequency current component generated by insulated gate bipolar transistors (IGBTs) switching on/off inside the inverter becomes leakage current through stray capacitance of inverter input and output wires or a motor. If any of the problems listed below occurs, take an appropriate measure against them.

| Problem | Measures |
|---|---|
| An earth leakage circuit breaker* that is connected to the input (primary) side has tripped.<br>*With overcurrent protection | 1) Decrease the carrier frequency. (See **Note** above.)<br>2) Make the wires between the inverter and motor shorter.<br>3) Use an earth leakage circuit breaker with lower sensitivity than the one currently used.<br>4) Use an earth leakage circuit breaker that features measures against the high frequency current component (Fuji SG and EG series). |
| An external thermal relay was falsely activated. | 1) Decrease the carrier frequency. (See **Note** above.)<br>2) Increase the current setting of the thermal relay.<br>3) Use the electronic thermal overload protection built in the inverter, instead of the external thermal relay. |

**Note** Running a permanent magnet synchronous motor (PMSM) at a low carrier frequency may heat the permanent magnet due to the output current harmonics, resulting in demagnetization. When decreasing the carrier frequency setting, be sure to check the allowable carrier frequency of the motor.

### 1.3.6 Precautions in driving a permanent magnet synchronous motor (PMSM)

When using a PMSM, note the following.

- When using a PMSM other than the Fuji standard synchronous motor (GNF2), consult your Fuji Electric representative.
- A single inverter cannot drive two or more PMSMs.
- A PMSM cannot be driven by commercial power.

# Chapter 2 MOUNTING AND WIRING THE INVERTER

## 2.1 Installing the Inverter

### (1) Mounting base

Install the inverter on a base made of metal or other non-flammable material. Do not mount the inverter upside down or horizontally.

**⚠WARNING**

Install the inverter on a base made of metal or other non-flammable material.
**Otherwise, a fire could occur.**

### (2) Clearances

Ensure that the minimum clearances indicated in Figure 2.1-1 and Table 2.1-1 are maintained at all times. When mounting the inverter in the panel of your system, take extra care with ventilation inside the panel as the surrounding temperature easily rises. Do not mount the inverter in a small panel with poor ventilation.

Figure 2.1-1 Mounting Direction and Required Clearances

■ When mounting two or more inverters

When mounting two or more inverters in the same unit or panel, basically lay them out side by side. When mounting them necessarily one above the other, be sure to separate them with a partition plate or the like so that any heat radiating from an inverter will not affect the one/s above.

As long as the surrounding temperature is 40°C or lower, inverters with a capacity of 22 kW or below can be mounted side by side without any clearance between them.

Table 2.1-1 Clearances (mm)

| Inverter capacity | A | B | C |
|---|---|---|---|
| 0.75 to 22 kW | 20 | 100 | 0 |
| 30 to 220 kW | 50 | | 100 |
| 280 to 630 kW | | 150 | 150 |

C: Space required in front of the inverter unit

■ When employing external cooling

In external cooling, the heat sink, which dissipates about 70% of the total heat (total loss) generated into air, is situated outside the equipment or the panel. The external cooling, therefore, significantly reduces heat radiating inside the equipment or panel.

To employ external cooling for inverters with a capacity of 22 kW or below, use the mounting adapter for external cooling (option); for those with a capacity of 30 kW or above, simply change the positions of the mounting bases.

For the dimensional outline drawing of the mounting adapter (option), refer to FRENIC-VG User's Manual, Chapter 8, Section 8.5.8.

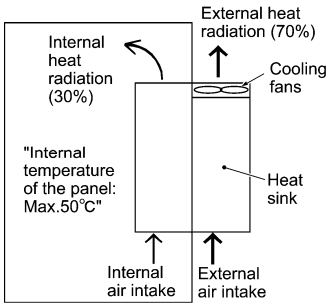



Figure 2.1-2 External Cooling

**⚠CAUTION**

Prevent lint, paper fibers, sawdust, dust, metallic chips, or other foreign materials from getting into the inverter or from accumulating on the heat sink.
**Otherwise, a fire or accident could occur.**

To utilize external cooling for inverters with a capacity of 30 kW or above, change the positions of the top and bottom mounting bases from the edge to the center of the inverter as shown in Figure 2.1-3.

Screws differ in size and count for each inverter. Refer to the table below.

For the panel cutting size, refer to Chapter 8, Section 8.3 "External Dimensions."

Table 2.1-2 Screw Size, Count and Tightening Torque

| Inverter type | Base fixing screw (Screw size and q'ty) | Case fixing screw (Screw size and q'ty) | Tightening torque (N·m) |
|---|---|---|---|
| FRN30VG1□-2□/FRN37VG1□-2□<br>FRN30VG1□-4□ to FRN55VG1□-4□ | M6 × 20<br>5 pcs for upper side,<br>3 pcs for lower side | M6 × 20<br>2 pcs for upper side | 5.8 |
| FRN45VG1□-2□/FRN55VG1□-2□<br>FRN75VG1□-4□ | M6 × 20<br>3 pcs each for upper and lower sides | M6 × 12<br>3 pcs for upper side | 5.8 |
| FRN75VG1□-2□<br>FRN90VG1□-4□/FRN110VG1□-4□ | M5 ×12<br>7 pcs each for upper and lower sides | M5 × 12<br>7 pcs for upper side | 3.5 |
| FRN132VG1□-4□/FRN160VG1□-4□ | M5 × 16<br>7 pcs each for upper and lower sides | M5 × 16<br>7 pcs for upper side | 3.5 |
| FRN90VG1□-2□<br>FRN200VG1□-4□/FRN220VG1□-4□ | M5 × 16<br>8 pcs each for upper and lower sides | M5 × 16<br>8 pcs for upper side | 3.5 |
| FRN280VG1□-4□/FRN315VG1□-4□<br>FRN355VG1□-4□/FRN400VG1□-4□ | M5 × 16<br>2 pcs each for upper and lower sides<br>M6 × 20<br>6 pcs each for upper and lower sides | M5 × 16<br>2 pcs each for upper and lower sides<br>M6 × 20<br>6 pcs each for upper and lower sides | 3.5<br>5.8 |
| FRN500VG1□-4□/FRN630VG1□-4□ | M8 × 20<br>8 pcs each for upper and lower sides | M8 × 20<br>8 pcs each for upper and lower sides | 13.5 |

1) Remove all of the base fixing screws and the case fixing screws from the top of the inverter.
2) Move the top mounting base to the center of the inverter and secure it to the case fixing screw holes with the base fixing screws. (After changing the position of the top mounting base, some screws may be left unused.)
3) Remove the base fixing screws from the bottom of the inverter, move the bottom mounting base to the center of the inverter, and secure it with the base fixing screws, just as in step 2). (Inverters with a capacity of 220 kW or below have no case fixing screws on the bottom.)

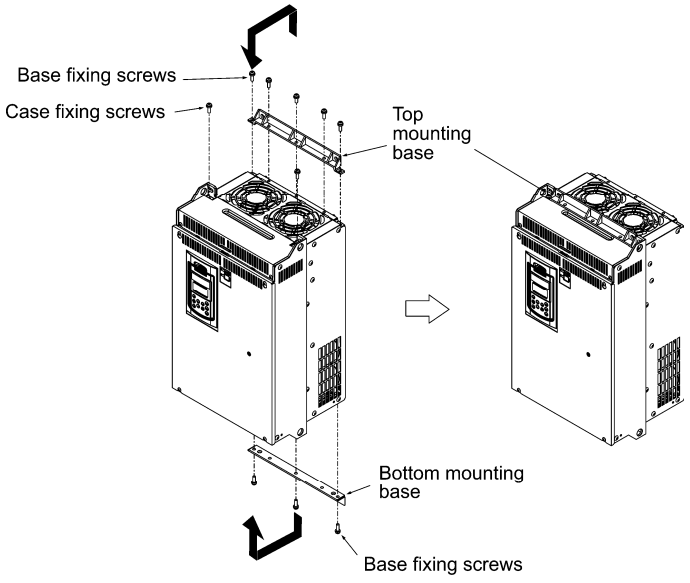
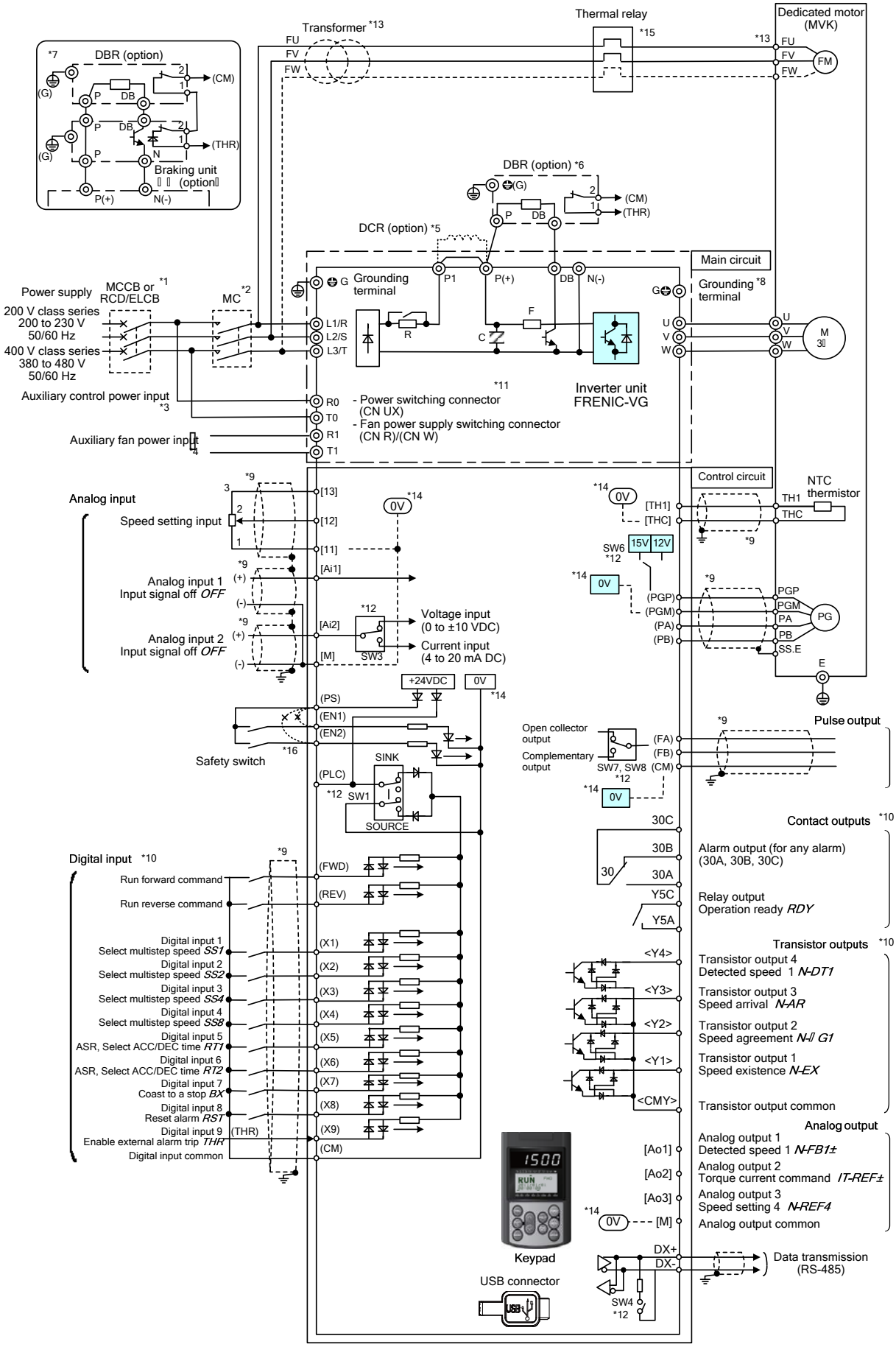



Figure 2.1-3 Changing the Positions of the Top and Bottom Mounting Bases

| ⚠CAUTION |
|---|
| When changing the positions of the top and bottom mounting bases, use only the specified screws.<br>**Otherwise, a fire or accident could occur.** |

## 2.2 Wiring

### 2.2.1 Connection diagram



(Note 1) Install a recommended molded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection function) in the primary circuit of the inverter to protect wiring. Ensure that the circuit breaker capacity is equivalent to or lower than the recommended capacity.

(Note 2) Install a magnetic contactor (MC) for each inverter to separate the inverter from the power supply, apart from the MCCB or RCD/ELCB, when necessary.
Connect a surge absorber in parallel when installing a coil such as the MC or solenoid near the inverter.

(Note 3) To retain an alarm output signal ***ALM*** issued on inverter's programmable output terminals by the protective function or to keep the keypad alive even if the main power has shut down, connect these terminals to the power supply lines. Without power supply to these terminals, the inverter can run.

(Note 4) Normally no need to be connected. Use these terminals when the inverter is equipped with a high power-factor, regenerative PWM converter (RHC series).

(Note 5) When connecting an optional DC reactor (DCR), remove the jumper bar from the main circuit terminals P1 and P(+).

Inverters of 75 kW or above and LD-mode inverters of 55 kW come with a DCR as standard. Be sure to connect the DCR.

Use a DCR when the capacity of the power supply transformer exceeds 500 kVA and is 10 times or more the inverter rated capacity, or when there are thyristor-driven loads in the same power supply line.

(Note 6) Inverters of 55 kW or below (200 V class series) and those of 160 kW or below (400 V class series) have a built-in braking transistor, allowing a braking resistor (DBR) to be directly connected between terminals P(+) and DB.

(Note 7) When connecting an optional braking resistor (DBR) to inverters of 75 kW or above (200 V class series) or those of 200 kW or above (400 V class series), be sure to use an optional braking unit (BU) together.

Connect the BU between terminals P(+) and N(-). Auxiliary terminals [1] and [2] have polarity, so make connection as shown in the connection diagram.

(Note 8) A grounding terminal for a motor. It is recommended that the motor be grounded via this terminal for suppressing inverter noise.

(Note 9) For wiring enclosed with , use twisted or shielded wires.

In principle, the shielded sheath of wires should be connected to ground. If the inverter is significantly affected by external induction noise, however, connection to (0V) ([M], [11], [THC]) or 0V ([CM], (PGM)) may be effective to suppress the influence of noise.

Keep the control circuit wiring away from the main circuit wiring as far as possible (recommended: 10 cm or more). Never install them in the same wire duct. When crossing the control circuit wiring with the main circuit wiring, set them at right angles.

(Note 10) The connection diagram shows factory default functions assigned to digital input terminals [X1] to [X9], transistor output terminals [Y1] to [Y4], and relay contact output terminals [Y5A/C].

(Note 11) Switching connectors in the main circuits. For details, refer to Section 2.2.7 "Switching connectors."

(Note 12) Slide switches on the control printed circuit board (control PCB). Use these switches to customize the inverter operations. For details, refer to Section 2.3.11 "Setting up the slide switches."

(Note 13) The cooling fan power supply for motors of 7.5 kW or less is single-phase. Connect terminals [FU] and [FV].

For motors of 7.5 kW or less (400 V class series), the power voltage/frequency rating of the cooling fan is 200 V/50 Hz or 200-230 V/60 Hz. For motors of 11 kW or above (400 V class series), it is 400-420 V/50 Hz or 400-440 V/60 Hz. To use the fan with power voltage other than the above specifications, a transformer is necessary.

(Note 14) (0V) ([M], [11], [THC]) and 0V ([CM], (PGM)) are insulated inside the inverter unit.

(Note 15) Use the auxiliary contact (manual reset) of the thermal relay to trip the MCCB or MC.

(Note 16) Jumper bars are mounted between safety terminals [EN1]/[EN2] and [PS] by factory default. To use the safety function, remove the jumper bars before connection of safety devices.

Follow the procedure below. (In the following description, the inverter has already been installed.)

Note In tables given in this manual, inverter types are denoted as "FRN_ _ _VG1□-2□/4□.

### 2.2.2 Removing and mounting the front cover and the wiring guide

| ⚠CAUTION |
|---|
| Be sure to disconnect the USB cable from the USB connector before removing the front cover.<br>**Otherwise, a fire or accident could occur.** |

**(1) For inverters with a capacity of 22 kW or below**

① First loosen the front cover fixing screw, hold the cover with both hands, slide it downward, tilt it toward you, and then pull it upward, as shown below.

② While pressing the wiring guide upward, pull it out toward you.

③ After carrying out wiring, put the wiring guide and the front cover back into place in the reverse order of removal.

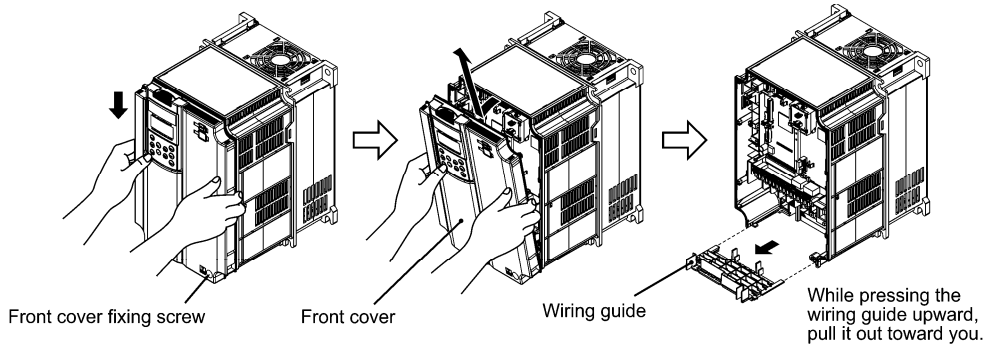


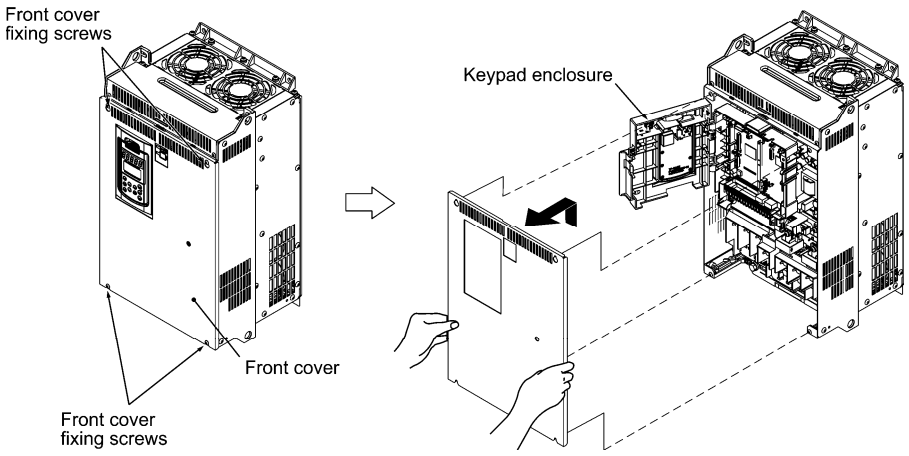

Figure 2.2-1 Removing the Front Cover and the Wiring Guide (FRN11VG1□-2□)

**(2) For inverters with a capacity of 30 to 630 kW**

① Loosen the four front cover fixing screws, hold the cover with both hands, slide it upward slightly, and pull it toward you, as shown below.

② After carrying out wiring, align the screw holes provided in the front cover with the screws on the inverter case, then put the front cover back into place in the reverse order of removal.

Tip To expose the control printed circuit board (control PCB), open the keypad enclosure.




Tightening torque: 1.8 N•m (M4)
3.5 N•m (M5)

Figure 2.2-2 Removing the Front Cover (FRN30VG1□-2□)

### 2.2.3 Wiring precautions

Follow the rules below when performing wiring for the inverter.

(1) Make sure that the source voltage is within the rated voltage range specified on the nameplate.

(2) Be sure to connect the three-phase power wires to the main circuit power input terminals L1/R, L2/S and L3/T of the inverter. If the power wires are connected to other terminals, the inverter will be damaged when the power is turned ON.

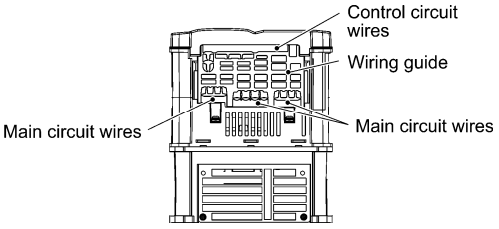
(3) Always connect the grounding terminal to prevent electric shock, fire or other disasters and to reduce electric noise.

(4) Use crimp terminals covered with insulated sleeves for the main circuit terminal wiring to ensure a reliable connection.

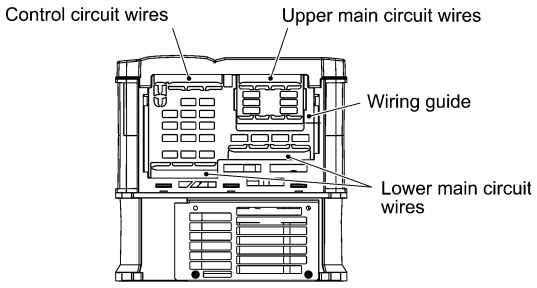
(5) Keep the power supply wiring (primary circuit) and motor wiring (secondary circuit) of the main circuit, and control circuit wiring as far away as possible from each other.

(6) After removing a screw from the main circuit terminal block, be sure to restore the screw even if no wire is connected.

(7) Use the wiring guide to separate wiring. For inverters with a capacity of 7.5 kW or below, the wiring guide separates the main circuit wires and the control circuit wires. For inverters with a capacity of 11 to 22 kW, it separates the upper and lower main circuit wires, and control circuit wires. Be careful about the wiring order.



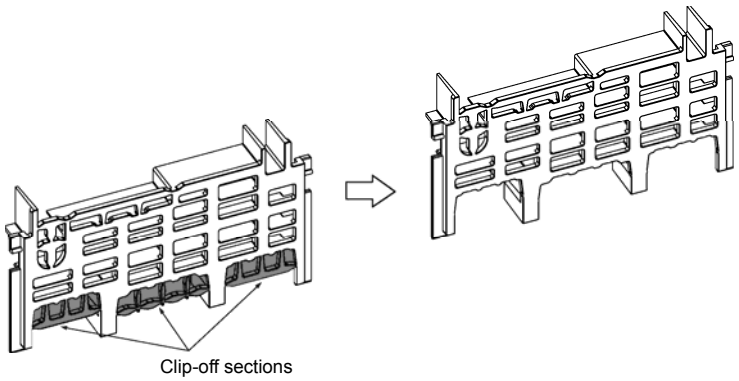

FRN7.5VG1□-2□




FRN22VG1□-2□

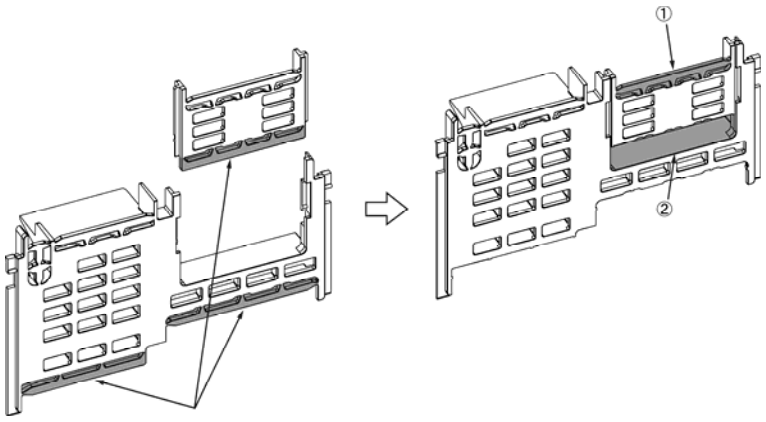
■ **Preparing for the wiring guide**

Inverters with a capacity of 22 kW or below are sometimes lacking in wiring space for main circuit wires depending upon the wire materials used. To assure a sufficient wiring space, remove the clip-off sections (see below) as required with a nipper. Note that the enclosure rating of IP20 is not ensured when the wiring guide itself is removed to secure a space for thick main circuit wiring.




Before removal of clip-off sections  After removal of clip-off sections

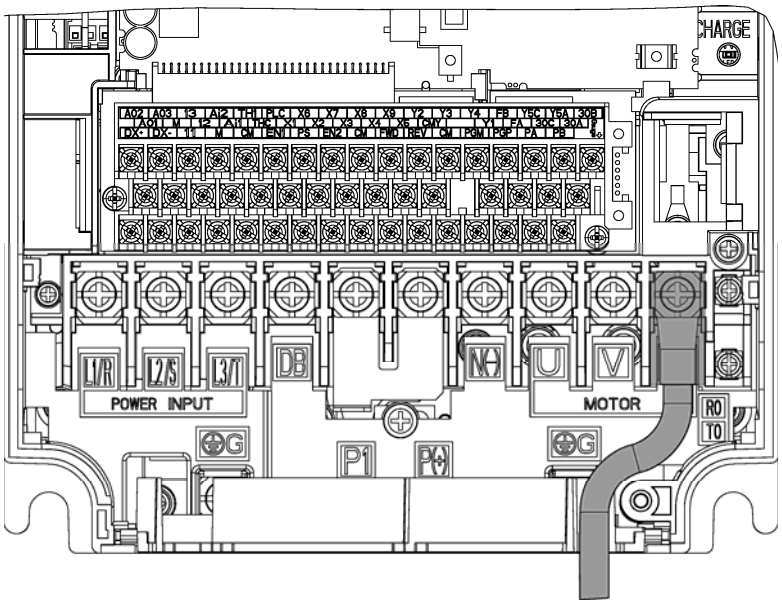
**Wiring Guide (FRN7.5VG1□-2□)**



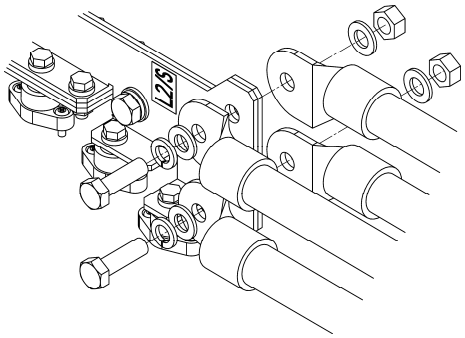

If the inverter output wire size is 22 mm$^2$, remove clip-off section ① before wiring.
If it is 38 mm$^2$, remove clip-off section ② before wiring.

**Wiring Guide (FRN22VG1□-2□)**

(8) In some types of inverters, the wires from the main circuit terminal block cannot be straight routed. Route such wires as shown below so that the front cover is set into place.




(9) For inverters with a capacity of 500 kW or 630 kW, two L2/S input terminals are arranged vertically to the terminal block. When connecting wires to these terminals, use the bolts, washers and nuts that come with the inverter, as shown below.



### 2.2.4 Wiring precautions

(1) If more than one motor is to be connected to a single inverter, the wiring length should be the sum of the length of the wires to the motors.

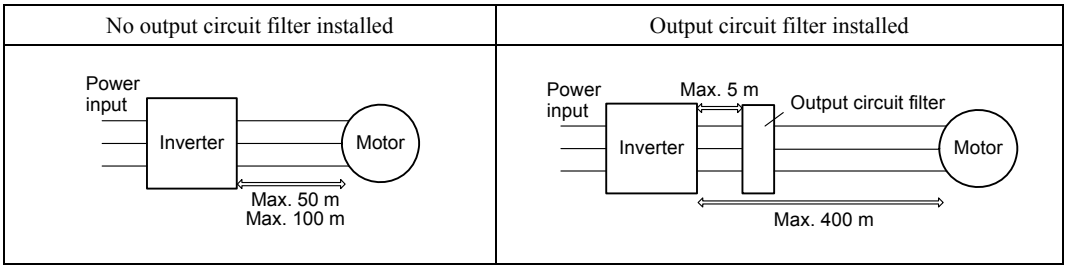
(2) Precautions for high frequency leakage currents

If the wiring distance between an inverter and a motor is long, high frequency currents flowing through stray capacitance across wires of phases may cause an inverter overheat, overcurrent trip, increase of leakage current, or it may not assure the accuracy in measuring leakage current. Depending on the operating condition, an excessive leakage current may damage the inverter.

To avoid the above problems when directly connecting an inverter to a motor, keep the wiring distance 50 m or less for inverters with a capacity of 3.7 kW or below, and 100 m or less for inverters with a higher capacity.

If the wiring distance longer than the specified above is required, lower the carrier frequency or insert an output circuit filter (OFL-□□□-□A) as shown below.

When a single inverter drives two or more motors connected in parallel (group drive), in particular, using shielded wires, the stray capacitance to the earth is large, so lower the carrier frequency or insert an output circuit filter (OFL-□□□-□A).




If using the motor with encoder, 100m below the wiring distance between the inverter and the motor. This is due to the limitation on the specifications of the encoder. If it exceeds 100m, the action is required, such as in the middle put the isolated converter.

If further longer secondary wiring is required, consult your Fuji Electric representative.

(3) Precautions for surge voltage in driving a motor by an inverter (especially for 400 V class motors)

If the motor is driven by a PWM-type inverter, surge voltage generated by switching the inverter component may be superimposed on the output voltage and may be applied to the motor terminals. Particularly if the wiring length is long, the surge voltage may deteriorate the insulation resistance of the motor. Implement any of the following measures.

- Use a motor with insulation that withstands the surge voltage. (All Fuji standard motors feature reinforced insulation.)
- Connect a surge suppressor unit (SSU50/100TA-NS) at the motor terminal.
- Connect an output circuit filter (OFL-□□□-□A) to the output terminals (secondary circuits) of the inverter.
- Minimize the wiring length between the inverter and motor (10 to 20 m or less).

(4) When an output circuit filter is inserted in the secondary circuit or the wiring between the inverter and the motor is long, a voltage loss occurs due to reactance of the filter or wiring so that the insufficient voltage may cause output current oscillation or a lack of motor output torque.

## ⚠WARNING

- When wiring the inverter to the power source, insert a recommended molded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) in the path of each pair of power lines to inverters. Use the recommended devices within the recommended current capacity.
- Be sure to use wires in the specified size.
- Tighten terminals with specified torque.

  **Otherwise, a fire could occur.**

- When there is more than one combination of an inverter and motor, do not use a multicore cable for the purpose of handling their wirings together.
- Do not connect a surge killer to the inverter's output (secondary) circuit.

  **Doing so could cause a fire.**

- Ground the inverter in compliance with the national or local electric code.
- Be sure to ground the inverter's grounding terminals ⏚G.

  **Otherwise, an electric shock or fire could occur.**

- Qualified electricians should carry out wiring.
- Be sure to perform wiring after shutting down the power.

  **Otherwise, electric shock could occur.**

- Be sure to perform wiring after installing the inverter unit.

  **Otherwise, electric shock or injuries could occur.**

- Ensure that the number of input phases and the rated voltage of the product match the number of phases and the voltage of the AC power supply to which the product is to be connected.

  **Otherwise, a fire or an accident could occur.**

- Do not connect the power source wires to inverter output terminals (U, V, and W).

  **Doing so could cause fire or an accident.**

### 2.2.5 Main circuit terminals

#### [ 1 ] Screw specifications and recommended wire sizes

The tables and figures given below show the screw specifications and wire sizes. Note that the terminal arrangements differ depending on the inverter types. In each of the figures, two grounding terminals (⏚G) are not exclusive to the power supply wiring (primary circuit) or motor wiring (secondary circuit).

Use crimp terminals covered with an insulation sheath or with an insulation tube. The recommended wire sizes for the main circuits are examples of using a single HIV wire (JIS C3317) (for 75°C) at a surrounding temperature of 50°C.

Table 2.2-1 Screw Specifications

| Inverter type | | Refer to Section 2.3.3. | Screw specifications | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Main circuit terminals | | Grounding terminals | | Auxiliary control power input terminals [R0, T0] | | Auxiliary fan power input terminals [R1, T1] | |
| Three-phase 200 V | Three-phase 400 V | | Screw size (Screw-driver size) | Tightening torque (N·m) | Screw size (Screw-driver size) | Tightening torque (N·m) | Screw size | Tightening torque (N·m) | Screw size | Tightening torque (N·m) |
| FRN0.75VG1□-2□ | FRN0.75VG1□-4□ | Figure A | M5 (No.2) | 3.5 | M5 (No.2) | 3.5 | M3.5 | 1.2 | -- | -- |
| FRN1.5VG1□-2□ | FRN1.5VG1□-4□ | | | | | | | | | |
| FRN2.2VG1□-2□ | FRN2.2VG1□-4□ | | | | | | | | | |
| FRN3.7VG1□-2□ | FRN3.7VG1□-4□ | | | | | | | | | |
| FRN5.5VG1□-2□ | FRN5.5VG1□-4□ | | | | | | | | | |
| FRN7.5G1□-2□ | FRN7.5VG1□-4□ | | | | | | | | | |
| FRN11VG1□-2□ | FRN11VG1□-4□ | Figure B | M6 (No.3) | 5.8 | M6 (No.3) | 5.8 | | | | |
| FRN15VG1□-2□ | FRN15VG1□-4□ | | | | | | | | | |
| FRN18.5VG1□-2□ | FRN18.5VG1□4□ | | | | | | | | | |
| FRN22VG1□-2□ | FRN22VG1□-4□ | | | | | | | | | |
| FRN30VG1□-2□ | FRN30VG1□-4□ | Figure C | M8 | 13.5 | M8 | 13.5 | | | | |
| | FRN37VG1□-4□ | | | | | | | | | |
| | FRN45VG1□-4□ | | | | | | | | | |
| | FRN55VG1□-4□ | | | | | | | | | |
| FRN37VG1□-2□ | FRN75VG1□-4□ | Figure D | M10 | 27 | | | | | M3.5 | 1.2 |
| FRN45VG1□-2□ | | | | | | | | | | |
| FRN55VG1□-2□ | | | | | | | | | | |
| -- | FRN90VG1□-4□ | Figure E | | | | | | | | |
| -- | FRN110VG1□-4□ | | | | | | | | | |
| FRN75VG1□-2□ | -- | Figure F | M12 | 48 | M10 | 27 | | | | |
| -- | FRN132VG1□-4□ | Figure G | | | | | | | | |
| -- | FRN160VG1□-4□ | | | | | | | | | |
| FRN90VG1□-2□ | FRN200VG1□-4□ | Figure H | | | | | | | | |
| | FRN220VG1□-4□ | | | | | | | | | |
| -- | FRN280VG1□-4□ | Figure I | | | | | | | | |
| -- | FRN315VG1□-4□ | | | | | | | | | |
| -- | FRN355VG1□-4□ | Figure J | | | | | | | | |
| -- | FRN400VG1□-4□ | | | | | | | | | |
| -- | FRN500VG1□-4□ | Figure K | | | | | | | | |
| -- | FRN630VG1□-4□ | | | | | | | | | |

## ⚠WARNING⚠

When the inverter power is ON, a high voltage is applied to the following terminals.

Main circuit terminals: L1/R, L2/S, L3/T, P1, P(+), N(-), DB, U, V, W, R0, T0, R1, T1, AUX-contact (30A, 30B, 30C, Y5A, Y5C)

Insulation level

Main circuit — Enclosure : Basic insulation (Overvoltage category III, Pollution degree 2)
Main circuit — Control circuit : Reinforced insulation (Overvoltage category III, Pollution degree 2)
Relay output — Control circuit : Reinforced insulation (Overvoltage category II, Pollution degree 2)

**An electric shock may occur.**

Table 2.2-2 Recommended Wire Sizes

| Power supply voltage | Nominal applied motor (kW) | Inverter type | | | Recommended wire size ($mm^2$) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Main circuit power input (L1/R, L2/S, L3/T) | | Grounding [⏚G] | Inverter output [U, V, W] | DCR [P1, P(+)] |
| | | HD mode | LD mode | MD mode | w/ DCR | w/o DCR | | | |
| Three-phase 200 V | 0.75 | FRN0.75VG1□-2□ | -- | -- | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| | 1.5 | FRN1.5VG1□-2□ | -- | -- | | | | | |
| | 2.2 | FRN2.2VG1□-2□ | -- | -- | | | | | |
| | 3.7 | FRN3.7VG1□-2□ | -- | -- | | | | | |
| | 5.5 | FRN5.5VG1□-2□ | -- | -- | | 3.5 | 3.5 | 3.5 | 3.5 |
| | 7.5 | FRN7.5VG1□-2□ | -- | -- | 3.5 | 5.5 | 5.5 | 5.5 | 5.5 |
| | 11 | FRN11VG1□-2□ | -- | -- | 5.5 | 14 | | 8.0 *3 | 8.0 *3 |
| | 15 | FRN15VG1□-2□ | -- | -- | 14 | 22 | 8.0 | 14 | 14 |
| | 18.5 | FRN18.5VG1□-2□ | -- | -- | | | | | 22 |
| | 22 | FRN22VG1□-2□ | -- | -- | 22 | 38 *1 | 14 | 22 | |
| | 30 | FRN30VG1□-2□ | -- | -- | 38 | 60 | | 38 | 38 |
| | 37 | FRN37VG1□-2□ | FRN30VG1□-2□ | -- | | | 22 | | 60 |
| | 45 | FRN45VG1□-2□ | FRN37VG1□-2□ | -- | 60 | 100 | | 60 | 100 |
| | 55 | FRN55VG1□-2□ | FRN45VG1□-2□ | -- | 100 | | | 100 | |
| | 75 | FRN75VG1□-2□ | FRN55VG1□-2□ | -- | 150 *2 | -- | | 150 *2 | 150 |
| | 90 | FRN90VG1□-2□ | FRN75VG1□-2□ | -- | 150 | | | 150 | 200 |
| | 110 | -- | FRN90VG1□-2□ | -- | 200 | | 38 | 200 | 250 |
| Three-phase 400 V | 3.7 | FRN3.7VG1□-4□ | -- | -- | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| | 5.5 | FRN5.5VG1□-4□ | -- | -- | | | | | |
| | 7.5 | FRN7.5VG1□-4□ | -- | -- | | | 3.5 | | |
| | 11 | FRN11VG1□-4□ | -- | -- | | 3.5 | | 3.5 | 3.5 |
| | 15 | FRN15VG1□-4□ | -- | -- | 3.5 | 5.5 | | | 5.5 |
| | 18.5 | FRN18.5VG1□-4□ | -- | -- | 5.5 | 8.0 *3 | 5.5 | 5.5 | |
| | 22 | FRN22VG1□-4□ | -- | -- | | 14 | | 8.0 *3 | 8.0 *3 |
| | 30 | FRN30VG1□-4□ | -- | -- | 14 | | 8.0 | 14 | 14 |
| | 37 | FRN37VG1□-4□ | FRN30VG1□-4□ | -- | | 22 | | | 22 |
| | 45 | FRN45VG1□-4□ | FRN37VG1□-4□ | -- | 22 | 38 | | 22 | |
| | 55 | FRN55VG1□-4□ | FRN45VG1□-4□ | -- | | | | 38 | 38 |
| | 75 | FRN75VG1□-4□ | FRN55VG1□-4□ | -- | 38 | | 14 | 60 | 60 |
| | 90 | FRN90VG1□-4□ | FRN75VG1□-4□ | -- | 60 | | | | 100 |
| | 110 | FRN110VG1□-4□ | FRN90VG1□-4□ | FRN90VG1□-4□ | 100 | | | 100 | |
| | 132 | FRN132VG1□-4□ | FRN110VG1□-4□ | FRN110VG1□-4□ | | | 22 | | 150 |
| | 160 | FRN160VG1□-4□ | FRN132VG1□-4□ | FRN132VG1□-4□ | 150 | | | 150 | |
| | 200 | FRN200VG1□-4□ | FRN160VG1□-4□ | FRN160VG1□-4□ | | | 38 | 200 | 250 |
| | 220 | FRN220VG1□-4□ | FRN200VG1□-4□ | FRN200VG1□-4□ | 200 | | | | |
| | 250 | -- | -- | FRN220VG1□-4□ | 250 | | | 250 | 325 |
| | 280 | -- | FRN220VG1□-4□ | -- | | | | 325 | 200x2 |
| | | FRN280VG1□-4□ | -- | -- | | | | | |
| | 315 | FRN315VG1□-4□ | -- | FRN280VG1□-4□ | 150x2 | | 60 | 200x2 | 250x2 |
| | 355 | FRN355VG1□-4□ | FRN280VG1□-4□ | FRN315VG1□-4□ | 200x2 | | | 250x2 | 325x2 |
| | 400 | FRN400VG1□-4□ | FRN315VG1□-4□ | FRN355VG1□-4□ | | | | | |
| | 450 | -- | FRN355VG1□-4□ | FRN400VG1□-4□ | 250x2 | | | | |
| | 500 | FRN500VG1□-4□ | FRN400VG1□-4□ | -- | 325x2 | | 100 | 325x2 | 325x3 |
| | 630 | FRN630VG1□-4□ | FRN500VG1□-4□ | -- | 325x3 | | | 325x3 | |
| | 710 | -- | FRN630VG1□-4□ | -- | 250x4 | | | 325x4 | 325x4 |

*1 Use the crimp terminal model No. 38-6 manufactured by JST Mfg. Co., Ltd., or equivalent.

*2 When using 150 $mm^2$ wires for main circuit terminals of FRN55VG1□-2□ (LD mode), use CB150-10 crimp terminals designed for low voltage appliances in JEM1399.

*3 Use the crimp terminal model No. 8-L6 manufactured by JST Mfg. Co., Ltd., or equivalent.

Table 2.2-3 Recommended Wire Size (Terminals common to all inverters)

| Terminals common to all inverters | Recommended wire size ($mm^2$) | Remarks |
|---|---|---|
| Auxiliary control power input terminals R0 and T0 | 2.0 | -- |
| Auxiliary fan power input terminals R1 and T1 | 2.0 | 200 V class series with 37 kW or above and 400 V class series with 75 kW or above |

## [ 2 ] Main circuit terminals

Figure A

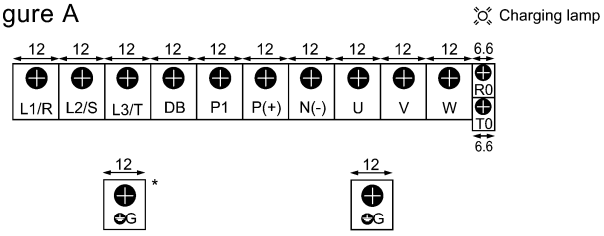



Figure B

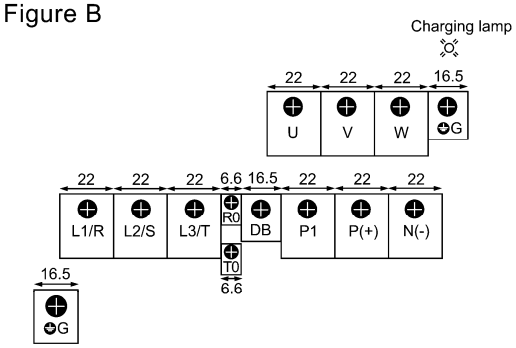



Figure C

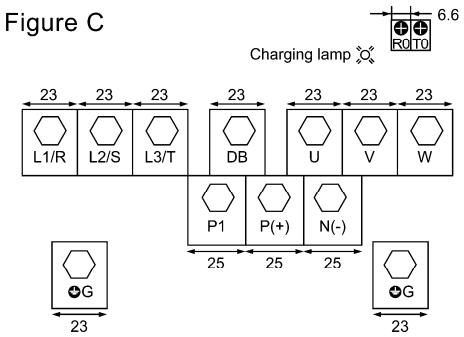



Figure D / Figure E

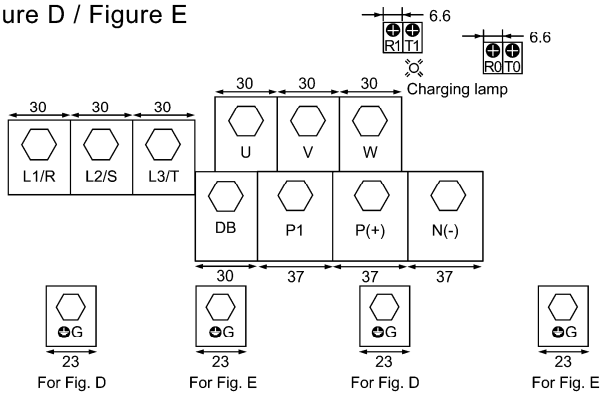



Figure F

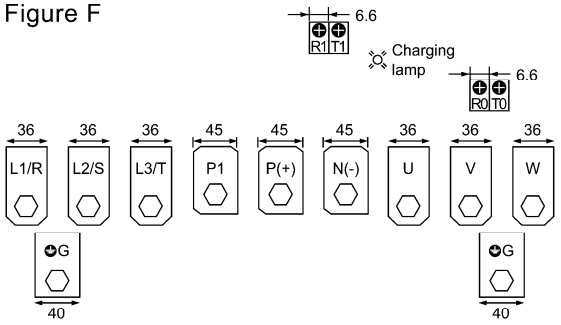



Figure G

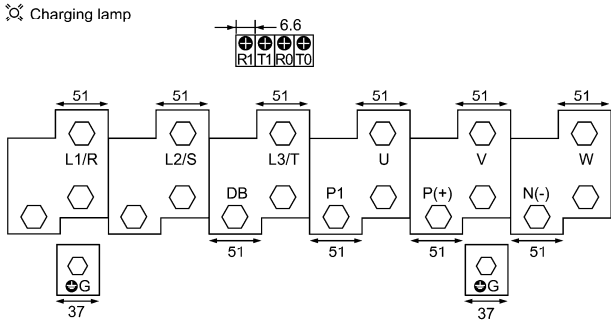



Figure H

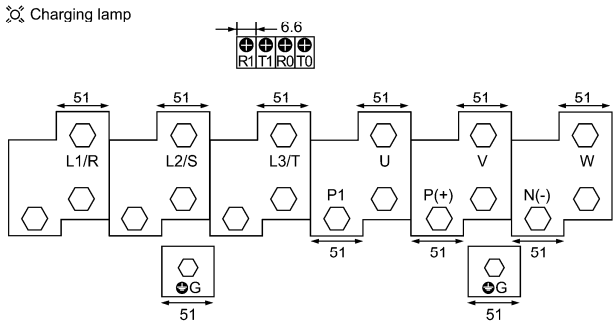


Figure I ⛭ Charging lamp

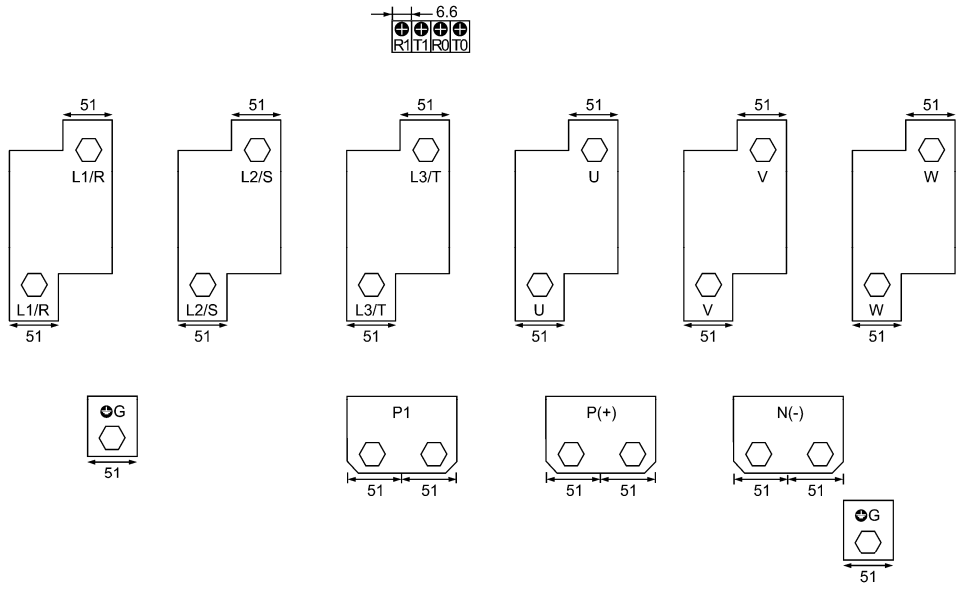



Figure J ⛭ Charging lamp

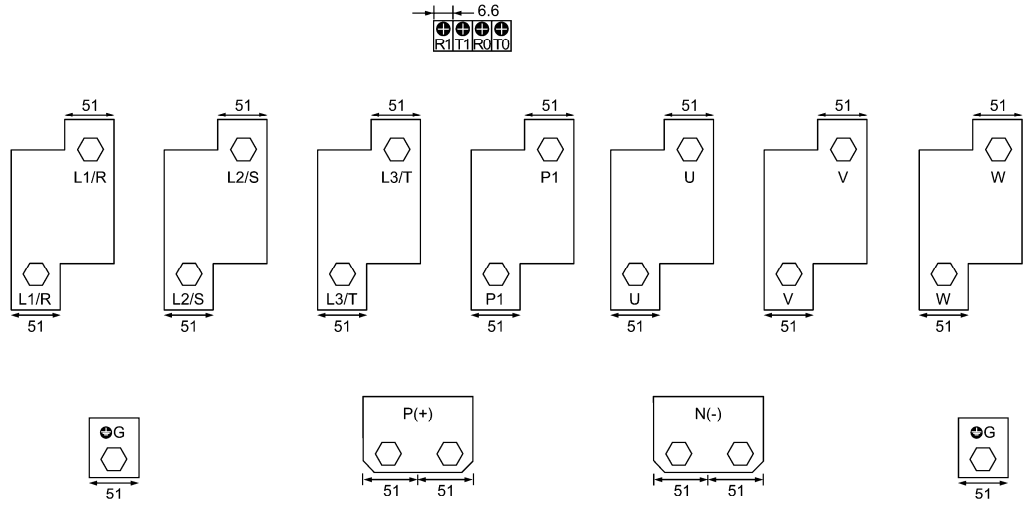
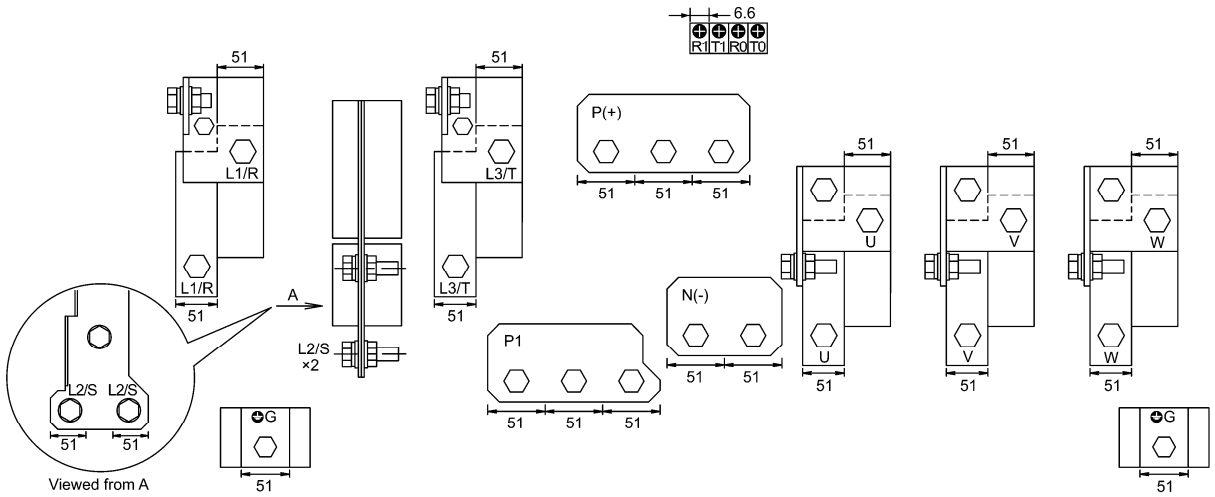



Figure K ⛭ Charging lamp



### [ 3 ] Detailed functions of main circuit terminals

| Classifi-cation | Symbol | Name | Functions |
|---|---|---|---|
| Main circuit | L1/R, L2/S, L3/T | Main circuit power inputs | Connect the three-phase input power lines. |
| | U, V, W | Inverter outputs | Connect a three-phase motor. |
| | P (+), P1 | DC reactor connection | Connect a DC reactor (DCR) for correcting power factor.<br>HD- and MD-mode inverters: A DCR is provided as an option for inverters of 55 kW or below, and as standard for those of 75 kW or above.<br>LD-mode inverters: A DCR is provided as an option for inverters of 45 kW or below, and as standard for those of 55 kW or above. |
| | P (+), N (-) | Braking unit connection | Connect a braking resistor (DBR) via a braking unit.<br>For connection to the DC link bus. |
| | P (+), DB | External braking resistor connection | Connect an optional external braking resistor. |
| | ⏚ G | Grounding for inverter | Grounding terminals of the inverter. |
| | R0, T0 | Auxiliary power input for the control circuit | For a backup of the control circuit power supply, connect AC power lines same as that of the main power input. |
| | R1, T1 | Auxiliary power input for the fans | For use in combination with a power regenerative PWM converter (RHC series), use these terminals for an auxiliary power input of the AC fans inside the inverter. (For 200 V class series of inverters with 37 kW or above and 400 V class series with 75 kW or above)<br>Normally, no need to use these terminals. |

#### ① Main circuit power input terminals L1/R, L2/S, and L3/T (three-phase input)

The three-phase input power lines are connected to these terminals.

1) For safety, make sure that the molded case circuit breaker (MCCB) or magnetic contactor (MC) is turned OFF before wiring the main circuit power input terminals.
2) Connect the main circuit power supply wires (L1/R, L2/S and L3/T) to the input terminals of the inverter via an MCCB or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB)*, and an MC if necessary.

   It is not necessary to align phases of the power supply wires and the input terminals of the inverter with each other.

   * With overcurrent protection

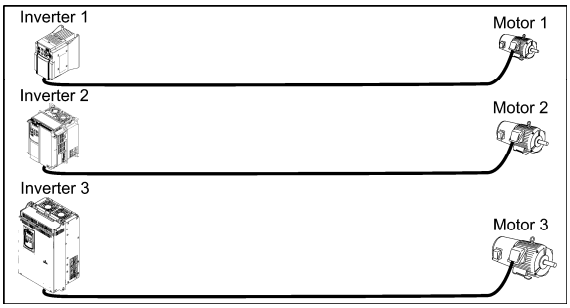
Tip It is recommended to insert a manually operable magnetic contactor (MC) that allows you to disconnect the inverter from the power supply in an emergency (e.g., when the protective function is activated), preventing a failure or accident from causing secondary disasters.

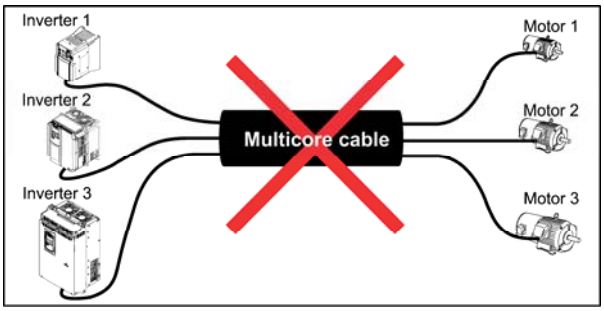
#### ② Inverter output terminals U, V, and W and secondary grounding terminals (⏚G) for motor

Inverter's output terminals should be connected as follows:

1) Connect the three wires of the 3-phase motor to terminals U, V, and W, aligning the phases each other.
2) Connect the secondary grounding wire to the grounding terminal (⏚G).

Note When there is more than one combination of an inverter and motor, do not use a multicore cable for the purpose of handling their wirings together.



### ③ DC reactor terminals P1 and P(+)

Connect a DC reactor (DCR) to these terminals for power factor correction.

1) Remove the jumper bar from terminals P1 and P(+).
   (Inverters of 75 kW or above and LD-mode inverters of 55 kW are not equipped with a jumper bar.)
2) Connect an optional DCR to those terminals.

Note
- The wiring length should be 10 m or below.
- Do not remove the jumper bar when a DCR is not used.
- For inverters of 75 kW or above and LD-mode inverters of 55 kW, a DCR is provided as standard. Be sure to connect the DCR to the inverter.
- When a PWM converter is connected to the inverter, no DCR is required.

**⚠WARNING**

Be sure to connect an optional DC reactor (DCR) when the capacity of the power supply transformer exceeds 500 kVA and is 10 times or more the inverter rated capacity.

**Otherwise, a fire could occur.**

### ④ DC braking resistor terminals P(+) and DB (Inverters of 55 kW or below for 200 V class series and those of 160 kW or below for 400 V class series)

1) Connect an optional DBR to terminals P(+) and DB.
2) Arrange the DBR and inverter so that the wiring length comes to 5 m or less and twist the two DBR wires or route them together in parallel.

**⚠WARNING**

When connecting a DC braking resistor (DBR), never connect it to terminals other than terminals P(+) and DB.

**Otherwise, a fire could occur.**

### ⑤ DC link bus terminals P(+) and N(-)

| Capacity (kW) | Braking transistor | Built-in DC braking resistor (DBR) | Optional devices | Devices and terminals |
|---|---|---|---|---|
| 75 to 90 (200 V)<br>200 to 630 (400 V) | None | None | Braking unit<br>DC braking resistor (DBR) | Inverter–Braking unit: P(+) and N(-) |

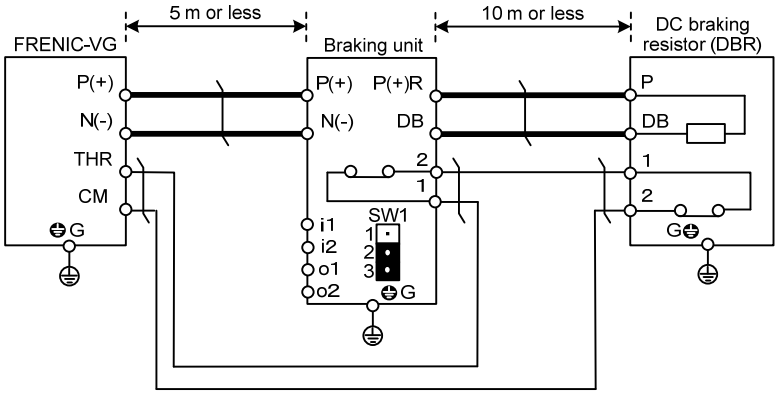
1) Connecting an optional braking unit or DC braking resistor (DBR)

   Inverters of 75 kW or above (200 V class series) and those of 200 kW or above (400 V class series) require both a braking unit and DBR.

   Connect the terminals P(+) and N(-) of a braking unit to those on the inverter. Arrange the inverter and the braking unit so that the wiring length comes to 5 m or less and twist the two wires or route them together in parallel.

   Next, connect the terminals P(+) and DB of a DBR to those on the braking unit. Arrange the braking unit and DBR so that the wiring length comes to 10 m or less and twist the two wires or route them together in parallel.

   For details about the wiring, refer to the Braking Unit Instruction Manual.




2) Connecting other external devices

   A DC link bus of other inverter(s) or a PWM converter is connectable to these terminals.

   For connection examples at the PWM converter side, refer to the FRENIC-VG User's Manual, Chapter 8, Section 8.5.2 "Power regenerative PWM converters, RHC series."

### ⑥ Primary grounding terminal (⏚G) for inverter enclosure

Two grounding terminals (⏚G) are not exclusive to the power supply wiring (primary circuit) or motor wiring (secondary circuit). Be sure to ground either of the two grounding terminals for safety and noise reduction. The inverter is designed for use with safety grounding to avoid electric shock, fire and other disasters.

The grounding terminal for inverter enclosure should be grounded as follows:

1) Ground the inverter in compliance with the national or local electric code.
2) Use a thick grounding wire with a large surface area and keep the wiring length as short as possible.

### ⑦ Auxiliary control power input terminals R0 and T0

In general, the inverter runs normally without power supplied to the auxiliary control power input terminals R0 and T0. If the inverter main power is shut down, however, no power is supplied to the control circuit so that the inverter cannot issue a variety of output signals or display on the keypad.

To retain an alarm output signal ***ALM*** issued on inverter's programmable output terminals by the protective function or to keep the keypad alive even if the main power has shut down, connect the auxiliary control power input terminals R0 and T0 to the power supply lines. If a magnetic contactor (MC) is installed in the inverter's primary circuit, connect the primary circuit of the MC to these terminals R0 and T0.

Terminal rating:

200 to 240 VAC, 50/60 Hz, Maximum current 1.0 A (200 V class series with 22 kW or below)
200 to 230 VAC, 50/60 Hz, Maximum current 1.0 A (200 V class series with 30 kW or above)
380 to 480 VAC, 50/60 Hz, Maximum current 0.5 A (400 V class series)

Note When introducing a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB), connect its output (secondary) side to terminals R0 and T0. Connecting its input (primary) side to those terminals causes the RCD/ELCB to malfunction since the input power voltage to the inverter is three-phase but the one to terminals R0 and T0 is single-phase. To avoid such problems, be sure to insert an insulation transformer or auxiliary B contacts of a magnetic contactor in the location shown in Figure 2.2-3.

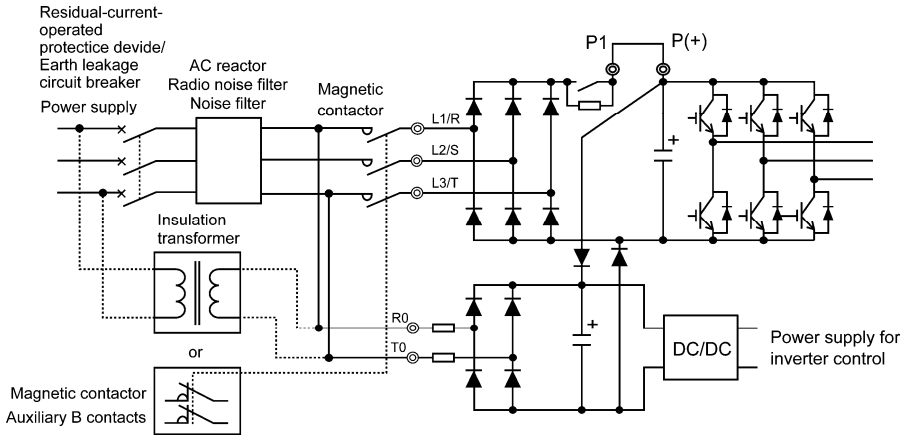



Figure 2.2-3 Connection Example of Residual-current-operated Protective Device (RCD)/ Earth Leakage Circuit Breaker (ELCB)

Note When connecting a PWM converter with an inverter, do not connect the power supply line directly to terminals R0 and T0. If a PWM is to be connected, insert an insulation transformer or auxiliary B contacts of a magnetic contactor at the power supply side.

For connection examples at the PWM converter side, refer to the FRENIC-VG User's Manual, Chapter 8, Section 8.5.2 "Power regenerative PWM converters, RHC series."

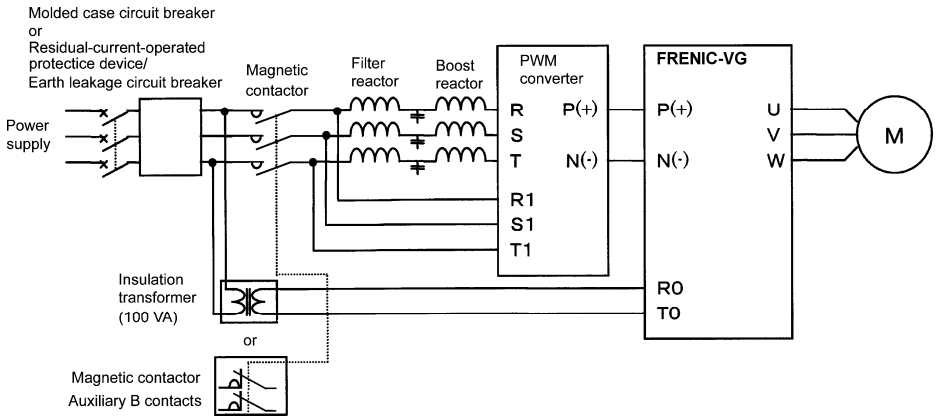



Figure 2.2-4 Connection Example of PWM Converter

**⑧ Auxiliary fan power input terminals R1 and T1**

The 200 V class series with 37 kW or above and 400 V class series with 75 kW or above are equipped with terminals R1 and T1. Only if the inverter works with the DC-linked power input whose source is a PWM converter, these terminals are used to feed AC power to the fans, while they are not used in any power system of ordinary configuration.
In this case, set up the fan power supply switching connectors (CN R and CN W).

Terminal rating:

200 to 220 VAC/50 Hz, 200 to 230 VAC/60 Hz, Maximum current 1.0 A (200 V class series with 37 kW or above)
380 to 440 VAC/50 Hz, 380 to 480 VAC/60 Hz, Maximum current 1.0 A (400 V class series with 75 kW to 400 kW)
380 to 440 VAC/50 Hz, 380 to 480 VAC/60 Hz, Maximum current 2.0 A (400 V class series with 500 kW and 630 kW)

### 2.2.6 Control circuit terminals (common to all inverter types)

#### [ 1 ] Screw specifications and recommended wire sizes

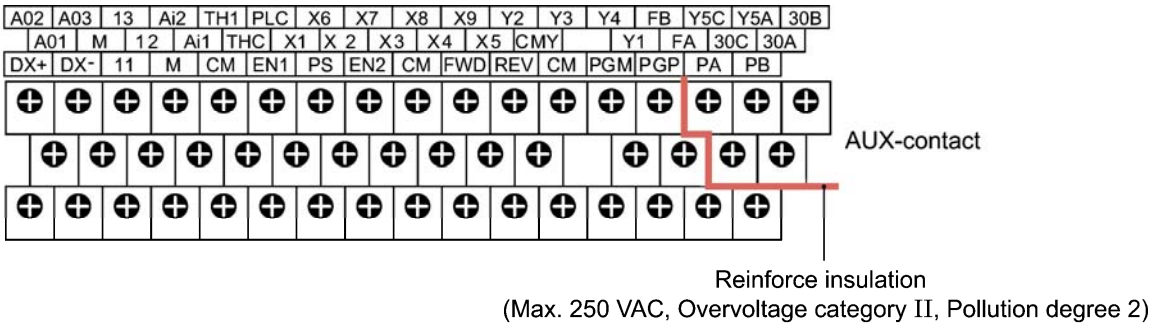
Table 2.2-4 lists the screw specifications and recommended wire size for wiring of the control circuit terminals. The control circuit terminals are common to all inverter types regardless of their capacities.

Table 2.2-4 Screw Specifications and Recommended Wire Size

| Terminals common to all inverter types | Screw specifications | | Recommended wire size ($mm^2$) |
|---|---|---|---|
| | Screw size | Tightening torque (N·m) | |
| Control circuit terminals | M3 | 0.7 | 1.25 * |

* Using wires exceeding the recommended sizes may lift the front cover depending upon the number of wires used, impeding keypad's normal operation.

#### [ 2 ] Arrangement of terminals



### [ 3 ] Detailed functions of control circuit terminals

**⚠WARNING**

In general, the covers of the control signal wires are not specifically designed to withstand a high voltage (i.e., reinforced insulation is not applied). Therefore, if a control signal wire comes into direct contact with a live conductor of the main circuit, the insulation of the cover might break down, which would expose the signal wire to a high voltage of the main circuit. Make sure that the control signal wires will not come into contact with live conductors of the main circuit.

**Failure to observe these precautions could cause electric shock or an accident.**

**⚠CAUTION**

Noise may be emitted from the inverter, motor and wires. Take appropriate measures to prevent the nearby sensors and devices from malfunctioning due to such noise.

It takes a maximum of 5 seconds to establish the input/output of the control circuit after the main power is turned ON. Take appropriate measures, such as external timers.

**An accident could occur.**

Table 2.2-5 lists the symbols, names and functions of the control circuit terminals. The wiring to the control circuit terminals differs depending upon the setting of the function codes, which reflects the use of the inverter. Route wires properly to reduce the influence of noise.

Table 2.2-5 Symbols, Names and Functions of the Control Circuit Terminals

| Classification | Symbol | Name | Functions |
|---|---|---|---|
| Analog input | [13] | Power supply for the potentiometer | Power supply (+10 VDC, 10mA Max) for an external speed command potentiometer. (Variable resistor: 1 to 5kΩ)<br>The potentiometer of 1/2 W rating or more should be connected. |
| | [12] | Analog setting voltage input | (1) The speed is commanded according to the external voltage input.<br>• 0 to ±10 VDC/0 to maximum speed<br>(2) Hardware specifications<br>• Input impedance: 10kΩ<br>• The maximum input is ±15 VDC, however, the voltage higher than ±10 VDC is regarded as ±10 VDC. |
| | [Ai1]<br>[Ai2] | Analog input 1<br>Analog input 2 | (1) Analog input voltage from external equipment.<br>Possible to assign various signal functions (Input signal off, Auxiliary speed setting 1, Torque limiter (level 1), etc.) selected with Function codes E49 and E50 to these terminals. For details, refer to Chapter 5, "Function Codes."<br>(2) Hardware specifications<br>Only for terminal [Ai2], the input is switchable between voltage and current with the SW3 configuration. (For details about slide switches, refer to Section 2.3.11.)<br>To use terminal [Ai2] for current input speed setting (***N-REFC***), turn SW3 to the I position, set F01 or C25 to "9" and set E50 to "26." After that, check that the current input is normal on the I./O check screen (given in Section 3.4.4.5).<br><u>Voltage input</u><br>• Input impedance: 10kΩ<br>• The maximum input is ±15 VDC, however, the voltage higher than ±10 VDC is regarded as ±10 VDC.<br><u>Current input (only on terminal [Ai2])</u><br>• Input impedance: 250Ω<br>• The maximum input is a maximum of 30 mADC; however, the current higher than 20 mADC is regarded as 20 mADC. |
| | [11]<br>[M] | Analog input common | Common for analog input signals ([12], [Ai1] and [Ai2]).<br>Isolated from terminals [CM], [CMY] and [PGM]. |

Table 2.3-5 Symbols, Names and Functions of the Control Circuit Terminals (Continued)

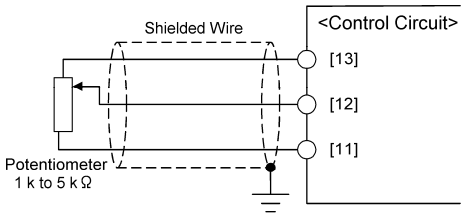
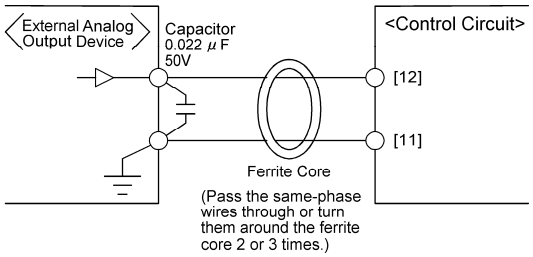
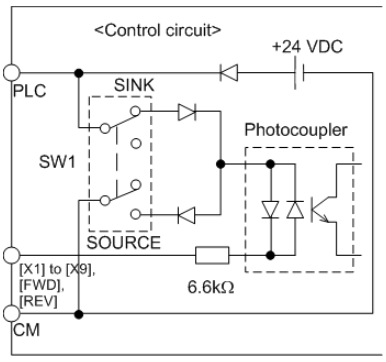
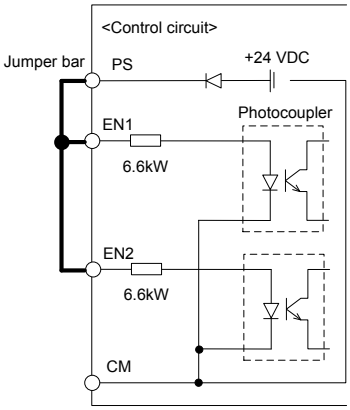
<table>
<tr><th>Classif-cation</th><th>Symbol</th><th>Name</th><th>Functions</th></tr>
<tr><td rowspan="4">Digital input</td><td colspan="3">Note<br>- Since low level analog signals are handled, these signals are especially susceptible to the external noise effects. Route the wiring as short as possible (within 20 m) and use shielded wires. In principle, ground the shielded sheath of wires; if effects of external inductive noises are considerable, connection to terminal [11] may be effective. As shown in Figure 2.2-5 and Figure 2.2-15., be sure to ground the single end of the shield to enhance the shield effect.<br>- Use a twin-contact relay for low level signals if the relay is used in the control circuit. Do not connect the relay's contact to terminal [11] or [M].<br>- When the inverter is connected to an external device outputting the analog signal, the external device may malfunction due to electric noise generated by the inverter. If this happens, according to the circumstances, connect a ferrite core (a toroidal core or equivalent) to the device outputting the analog signal or connect a capacitor having the good cut-off characteristics for high frequency between control signal wires as shown in Figure 2.2-5 and Figure 2.2-15.<br>  <br><br>Figure 2.2-5 Connection of Shielded Wire<br>  <br><br>Figure 2.2-6 Example of Electric Noise Reduction</td></tr>
<tr><td>[FWD]</td><td>Run forward command</td><td>(1) When terminals [FWD] and [CM] are closed, the motor runs in the forward direction. When they are opened, the motor decelerates to a stop. (SINK)<br>When terminals [FWD] and [PLC] are closed, the motor runs in the forward direction. When they are opened, the motor decelerates to a stop. (SOURCE)<br>(2) Input mode, i.e. SINK/SOURCE, is changeable by using the slide switch SW1. (Refer to Section 2.2.8 "Setting up the slide switches."</td></tr>
<tr><td>[REV]</td><td>Run reverse command</td><td>(1) When terminals [REV] and [CM] are closed, the motor runs in the forward direction. When they are opened, the motor decelerates to a stop. (SINK)<br>When terminals [REV] and [PLC] are closed, the motor runs in the forward direction. When they are opened, the motor decelerates to a stop. (SOURCE)<br>(2) Input mode, i.e. SINK/SOURCE, is changeable by using the slide switch SW1. (Refer to Section 2.2.8 "Setting up the slide switches."</td></tr>
<tr><td>[X1]<br>[X2]<br>[X3]<br>[X4]<br>[X5]<br>[X6]<br>[X7]<br>[X8]<br>[X9]</td><td>Digital input 1<br>Digital input 2<br>Digital input 3<br>Digital input 4<br>Digital input 5<br>Digital input 6<br>Digital input 7<br>Digital input 8<br>Digital input 9</td><td>(1) Various signals such as "Coast to a stop," "Enable external alarm trip," and "Select multistep speed" can be assigned to these terminals by setting Function codes E01 to E09. For details, refer to Chapter 5 "Function Codes."<br>(2) Input mode, i.e. SINK/SOURCE, is changeable by using the slide switch SW1. (Refer to Section 2.2.8 "Setting up the slide switches."<br>(3) Switches the logic value (1/0) for ON/OFF of the terminals [X1] to [X9]. If the logic value for ON of the terminal [X1] is 1 in the normal logic system, for example, OFF is 1 in the negative logic system and vice versa.<br>(Digital input circuit specifications)<br>  <br><br>Figure 2.2-7 Digital Input Circuit<br><table><tr><th colspan="2">Item</th><th>Min.</th><th>Max.</th></tr><tr><td rowspan="2">Operating voltage (SINK)</td><td>ON level</td><td>0 V</td><td>2 V</td></tr><tr><td>OFF level</td><td>22 V</td><td>27 V</td></tr><tr><td rowspan="2">Operating voltage (SOURCE)</td><td>ON level</td><td>22 V</td><td>27 V</td></tr><tr><td>OFF level</td><td>0 V</td><td>2 V</td></tr><tr><td colspan="2">Operating current at ON (Input voltage is at 0 V)</td><td>–</td><td>4.5 mA</td></tr><tr><td colspan="2">Allowable leakage current at OFF</td><td>–</td><td>0.5 mA</td></tr></table></td></tr>
</table>

Table 2.2-5 Symbols, Names and Functions of the Control Circuit Terminals (Continued)

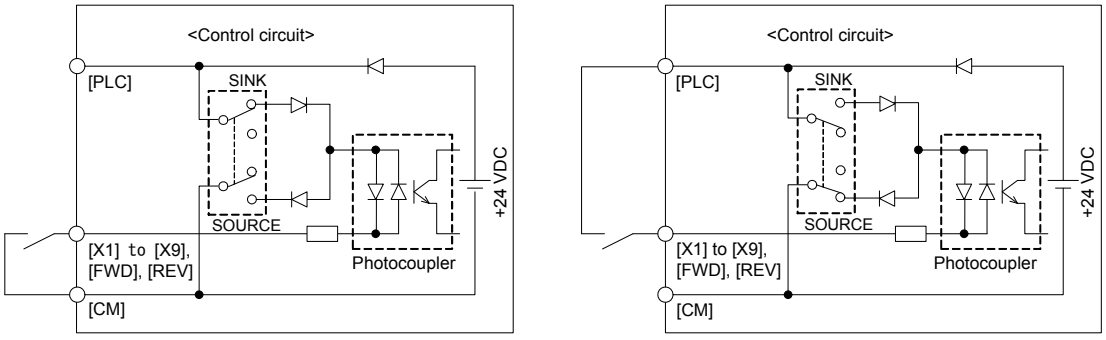
| Classification | Symbol | Name | Functions |
|---|---|---|---|
| Digital input | [EN1]<br>[EN2] | Enable input | (1) When [EN1]-[PS] or [EN2]-[PS] is opened (OFF), the inverter output transistor stops its operation. (Safe Torque Off, STO)<br>To enable the STO function, remove the jumper bars.<br>(2) The input mode of terminals [EN1] and [EN2] is fixed at SOURCE. It cannot be switched to SINK.<br>(3) When not using the Enable input function, short the circuit between [EN1]-[PS] and [EN2]-[PS] with jumper bars (that is, keep the short bars connected).<br>(Terminal EN circuit specification)<br>  <br><br>Item / ON level / OFF level / Min. / Max.<br>Operating voltage (SOURCE): ON level 22 V, 27 V; OFF level 0 V, 2 V<br>Operating current at ON (Input voltage is at 0 V): – / 4.5 mA<br>Allowable leakage current at OFF: – / 0.5 mA |
| | [PS] | [EN] terminal power | Power terminal for terminals [EN1] and [EN2].<br>This terminal outputs +24 VDC (Reference for terminal [CM]). |
| | [PLC] | PLC signal power | (1) Connects to PLC output signal power supply.<br>Rated voltage: +24 VDC (Allowable range: +22 to +27 VDC), Maximum 100 mA DC<br>(2) This terminal also supplies a power to the load connected to the transistor output terminals. Refer to "Transistor output" described later in this table for more. |
| | [CM] | Digital input common | Two common terminals for digital input signals<br>Electrically isolated from terminals [11], [M], and [CMY]. |

Tip

■ Using a relay contact to turn [FWD], [REV], or [X1] to [X9] ON or OFF

Figure 2.2-8 shows two examples of a circuit configuration that uses a relay contact to turn control signal input [X1] to [X9], [FWD], or [REV] ON or OFF. In circuit (a), the slide switch is turned to SINK, whereas in circuit (b) it is turned to SOURCE.

**Note:** To configure this kind of circuit, use a highly reliable relay.
(Recommended product: Fuji control relay Model HH54PW.)




(a) With the switch turned to SINK (b) With the switch turned to SOURCE

Figure 2.2-8 Circuit Configuration Using a Relay Contact

Table 2.2-5 Symbols, Names and Functions of the Control Circuit Terminals (Continued)

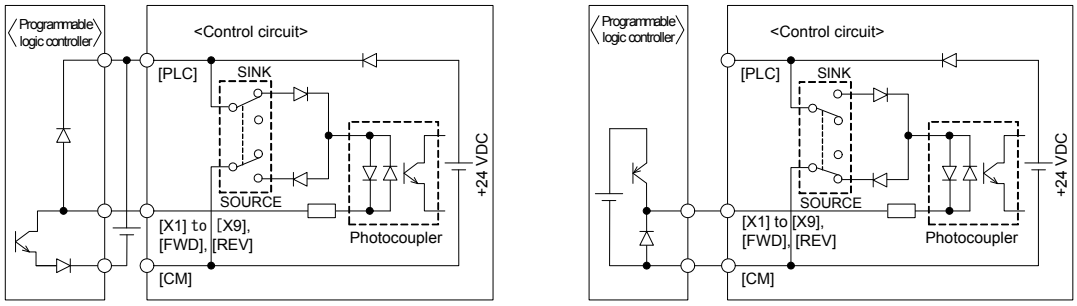
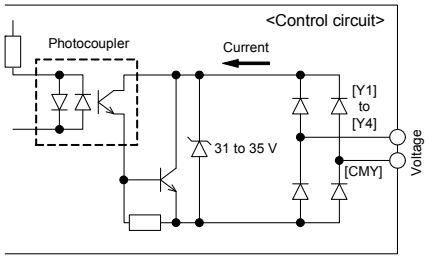
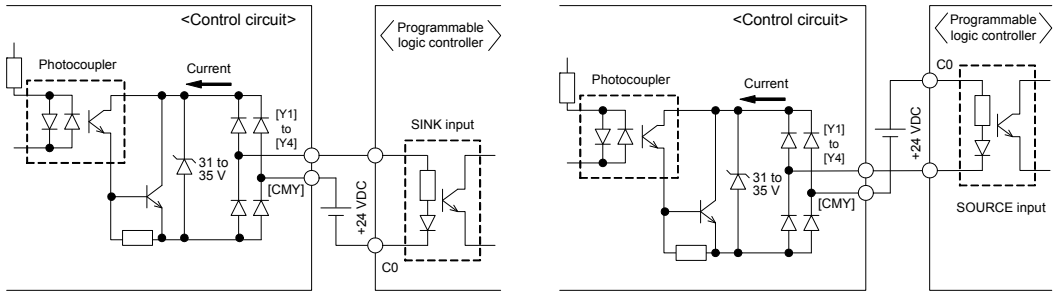
<table>
<tr><th>Classif-cation</th><th>Symbol</th><th>Name</th><th>Functions</th></tr>
<tr><td>Digital input</td><td colspan="3">
Tip ■ Using a programmable logic controller (PLC) to turn [FWD], [REV], or [X1] to [X9] ON or OFF<br>
Figure 2.2-9 shows two examples of a circuit configuration that uses a programmable logic controller (PLC) to turn control signal input [X1] to [X9], [FWD], or [REV] ON or OFF. In circuit (a), the slide switch is turned to SINK, whereas in circuit (b) it is turned to SOURCE.<br>
In circuit (a) below, short-circuiting or opening the transistor's open collector circuit in the PLC using an external power supply turns ON or OFF control signal [FWD], [REV], or [X1] to [X9]. When using this type of circuit, observe the following:<br>
- Connect the + node of the external power supply (which should be isolated from the PLC's power) to terminal [PLC] of the inverter.<br>
- Do not connect terminal [CM] of the inverter to the common terminal of the PLC.<br>

<br>
(a) With the switch turned to SINK (b) With the switch turned to SOURCE<br>
Figure 2.2-9 Circuit Configuration Using a PLC<br>
For details about the slide switch setting, refer to Section 2.2.8 "Setting up the slide switches."
</td></tr>
<tr><td rowspan="2">Analog output</td><td>[Ao1]<br>[Ao2]<br>[Ao3]</td><td>Analog output 1<br>Analog output 2<br>Analog output 3</td><td>(1) Output of monitor signals with analog voltage 0 to ±10 VDC.<br>Various signals such as "Detected speed," "Speed setting," and "Torque current command" can be assigned to these terminals by setting Function codes E67 to E71. For details, refer to Chapter 5 "Function Codes."<br>(2) Hardware specifications<br>• Connectable impedance: Min. 3kΩ<br>• Gain adjustment range: 0 to ±100 times</td></tr>
<tr><td>[M]</td><td>Analog common</td><td>Common for analog output signals ([Ao1], [Ao2] and [Ao3]).<br>Electrically isolated from terminals [CM], [CMY] and [PGM].</td></tr>
</table>

Table 2.2-5 Symbols, Names and Functions of the Control Circuit Terminals (Continued)

<table>
<tr><th>Classification</th><th>Symbol</th><th>Name</th><th>Functions</th></tr>
<tr><td rowspan="3">Transistor output</td><td>[Y1]<br>[Y2]<br>[Y3]<br>[Y4]</td><td>Transistor output 1<br>Transistor output 2<br>Transistor output 3<br>Transistor output 4</td><td>(1) Various signals such as "Inverter running," "Speed valid," and "Speed agreement" can be assigned to these terminals by setting Function codes E15 to E18. For details, refer to Chapter 5 "Function Codes."<br>(2) Switches the logic value (1/0) for ON/OFF of the terminals between [Y1] to [Y4], and [CMY]. If the logic value for ON between [Y1] to [Y4] and [CMY] is 1 in the normal logic system, for example, OFF is 1 in the negative logic system and vice versa.<br>(Transistor output circuit specification)<br> 

<table>
<tr><th colspan="2">Item</th><th>Max.</th></tr>
<tr><td rowspan="2">Operation voltage</td><td>ON level</td><td>2 V</td></tr>
<tr><td>OFF level</td><td>27 V</td></tr>
<tr><td colspan="2">Maximum current at ON</td><td>50 mA</td></tr>
<tr><td colspan="2">Leakage current at OFF</td><td>0.1 mA</td></tr>
</table>
Figure 2.2-10 Transistor Output Circuit<br>Note - When a transistor output drives a control relay, connect a surge-absorbing diode across relay's coil terminals.<br>- When any equipment or device connected to the transistor output needs to be supplied with DC power, feed the power (+24 VDC: allowable range: +22 to +27 VDC, 100 mA max.) through the [PLC] terminal. Short-circuit between the terminals [CMY] and [CM] in this case.</td></tr>
<tr><td>[CMY]</td><td>Transistor output common</td><td>Common terminal for transistor output signals<br>Electrically isolated from terminals [CM], [11], [M], and [PGM].</td></tr>
<tr><td colspan="3">Tip ■ Connecting programmable logic controller (PLC) to terminal [Y1], [Y2], [Y3] or [Y4]<br>Figure 2.2-11 shows two examples of circuit connection between the transistor output of the inverter's control circuit and a PLC. In example (a), the input circuit of the PLC serves as a SINK for the control circuit output, whereas in example (b), it serves as a SOURCE for the output.<br> 

(a) PLC serving as SINK (b) PLC serving as SOURCE<br>Figure 2.2-11 Connecting PLC to Control Circuit</td></tr>
<tr><td rowspan="2">Relay output</td><td>[Y5A/C]</td><td>General purpose relay output</td><td>(1) A general-purpose relay contact output usable as well as the function of the transistor output terminal [Y1], [Y2], [Y3] or [Y4].<br>Contact rating: 250 VAC 0.3 A, cos ϕ = 0.3, 48 VDC, 0.5 A<br>(2) Switching of the normal/negative logic output is applicable to the following two contact output modes: "Active ON" (Terminals [Y5A] and [Y5C] are closed (excited) if the signal is active.) and "Active OFF" (Terminals [Y5A] and [Y5C] are opened (non-excited) if the signal is active while they are normally closed.).</td></tr>
<tr><td>[30A/B/C]</td><td>Alarm relay output (for any error)</td><td>(1) Outputs a contact signal (SPDT) when a protective function has been activated to stop the motor.<br>Contact rating: 250 VAC, 0.3A, cos ϕ = 0.3, 48 VDC, 0.5A<br>(2) Switching of the normal/negative logic output is applicable to the following two contact output modes: "Active ON" (Terminals [30A] and [30C] are closed (excited) if the signal is active.) and "Active OFF" (Terminals [30A] and [30C] are opened (non-excited) if the signal is active while they are normally closed.).</td></tr>
</table>

Table 2.2-5 Symbols, Names and Functions of the Control Circuit Terminals (Continued)

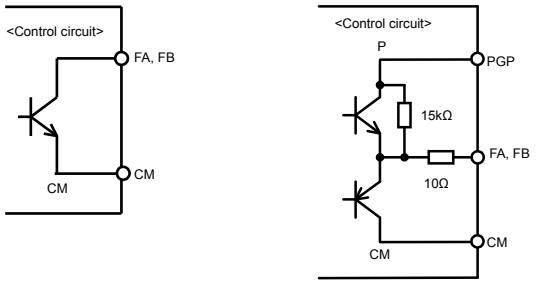
<table>
<tr><th>Classif-cation</th><th>Symbol</th><th>Name</th><th>Functions</th></tr>
<tr><td rowspan="3">Communication</td><td>RJ-45 connector for the keypad</td><td>RS-485 communications port 1 (Connector for keypad)</td><td>Connector to join the keypad to the inverter.<br>Power is supplied to the keypad from the inverter via a remote operation extension cable.</td></tr>
<tr><td>[DX+]/ [DX-]</td><td>RS-485 communications port 2 (Terminals on control PCB)</td><td>Input/output terminals to transmit data through the RS-485 multipoint protocol between the inverter and a computer or other equipment such as a PLC.<br>(For setting of the terminating resistor, refer to Section 2.2.8 "Setting up the slide switches.")</td></tr>
<tr><td>USB connector</td><td>USB port (On the keypad)</td><td>A USB port connector (mini B) that connects an inverter to a computer. FRENIC-VG Loader (inverter support software*) running on the computer supports editing the function codes, transferring them to the inverter, verifying them, test-running an inverter and monitoring the inverter running status.<br>* FRENIC-VG Loader (free version) is available as an install from the CD-ROM (that comes with the inverter as an accessory) or as a free download from our website at:<br>http://www.fujielectric.com/products/<br>The free version supports editing, transferring and verifying of function codes and the traceback function.</td></tr>
<tr><td rowspan="5">Speed detection</td><td>[PA]<br>[PB]</td><td>Pulse generator 2-phase signal input</td><td>The PG interface uses a complementary output mode.<br>[PA]: Input terminal for A phase of the pulse generator<br>[PB]: Input terminal for B phase of the pulse generator<br>When 12V power supply is in use: H level ≥ 9V, L level ≤ 1.5V<br>When 15V power supply is in use: H level ≥ 12V, L level ≤ 1.5V<br>Input pulse frequency: 100 kHz or below, Duty: 50 ±10%<br>Wiring length: 100 m or less<br>(Note) False detection may occur due to noise. Make the wiring length as short as possible and take sufficient noise control measures.</td></tr>
<tr><td>[PGP]</td><td>Pulse generator power supply</td><td>Power supply terminal for a pulse generator.<br>Output: +12 VDC ±10% or +15 VDC ±10%<br>Maximum current: 270 mA<br>(For output voltage switching, refer to Section 2.2.8 "Setting up the slide switches.")</td></tr>
<tr><td>[PGM]</td><td>Common terminal</td><td>Common terminal for pulse generator power/signal.<br>Electrically isolated from terminals [11], [M] and [CMY].<br>Not electrically isolated from terminal [CM], but not equivalent voltage.</td></tr>
<tr><td>[FA]<br>[FB]</td><td>Pulse generator output</td><td>(1) This outputs pulse generator signals with frequency divided to 1/n (where, n is programmable with Function code E29).<br>(2) Switchable between open collector and complementary (equivalent to the voltage on the [PGP] terminal) transistor outputs.<br>(For switching, refer to Section 2.2.8 "Setting up the slide switches.")<br>  <br><br>(a) Open collector output (b) Complementary output<br>Figure 2.2-12 Pulse Output Circuit<br><table><tr><th colspan="2">Items</th><th>Min.</th><th>Max.</th><th>Remarks</th></tr><tr><td rowspan="2">Output voltage (Open collector output)</td><td>Output voltage</td><td>-</td><td>2 V</td><td></td></tr><tr><td>Max. output current</td><td>-</td><td>15 mA</td><td></td></tr><tr><td rowspan="3">Output voltage (Complementary output)</td><td>Hi level output</td><td>PGP-3V</td><td>-</td><td></td></tr><tr><td>Low level output</td><td>-</td><td>2 V</td><td></td></tr><tr><td>Max. output current</td><td>-</td><td>20 mA</td><td></td></tr></table></td></tr>
<tr><td>[CM]</td><td>Pulse generator output common</td><td>Common terminal for [FA] and [FB].</td></tr>
</table>

Table 2.2-5 Symbols, Names and Functions of the Control Circuit Terminals (Continued)

| Classification | Symbol | Name | Functions |
|---|---|---|---|
| Temperature detection | [TH1] | NTC/PTC thermistor connection | Monitors the motor temperature with NTC or PTC thermistor.<br>For a PTC thermistor, the motor overheat protection level can be specified with Function code E32. |
| | [THC] | Common | Common terminal for NTC and PTC thermistors.<br>Electrically isolated from terminals [CM], [PGM], and [CMY] |

**[ 4 ] Wiring for control circuit terminals, for inverters of 75 kW (200 V class series) and those of 132-630 kW (400 V class series)**

For FRN75VG1☐-2☐, FRN90VG1☐-2☐ and FRN132VG1☐-4☐ to FRN630VG1☐-4☐

(1) As shown in Figure 2.2-13, route the control circuit wires along the left side panel to the outside of the inverter.

(2) Secure those wires to the wiring support, using a cable tie (e.g., Insulok) with 3.8 mm or less in width and 1.5 mm or less in thickness.

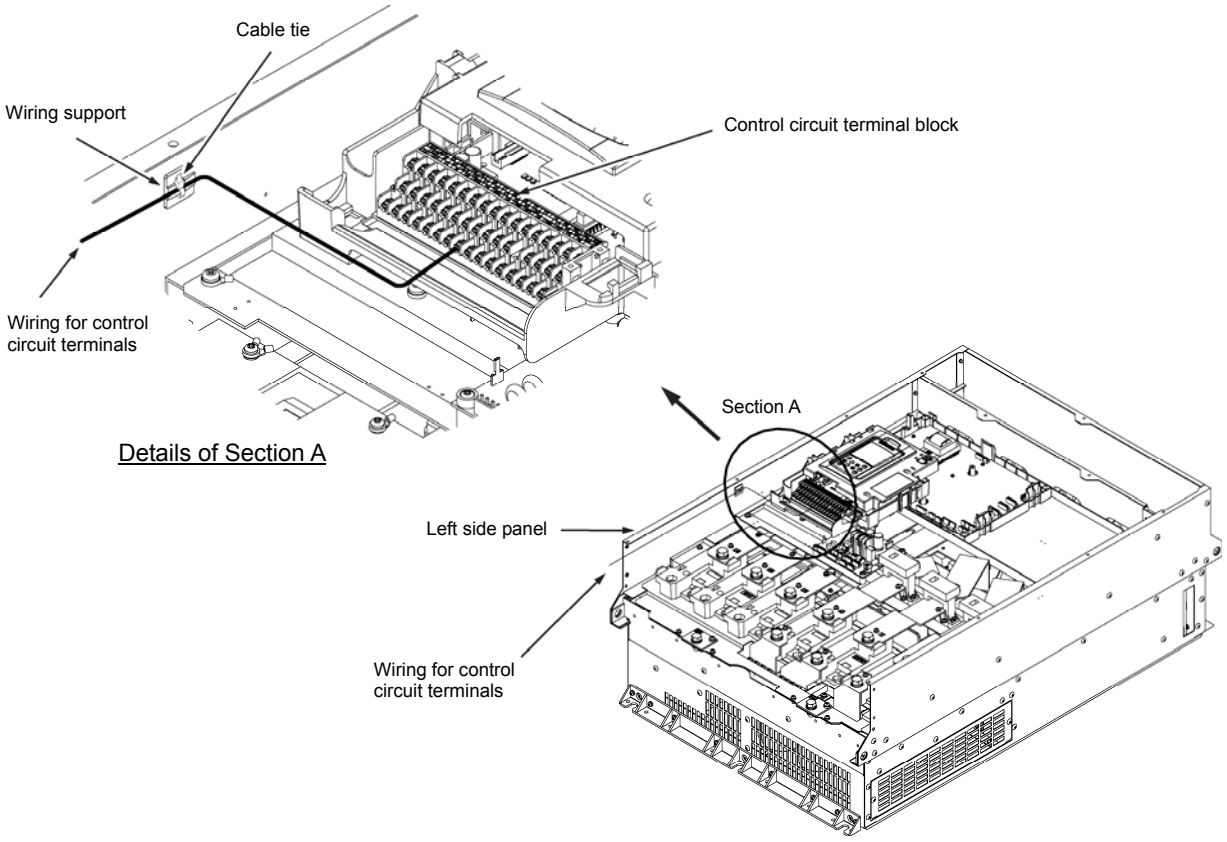


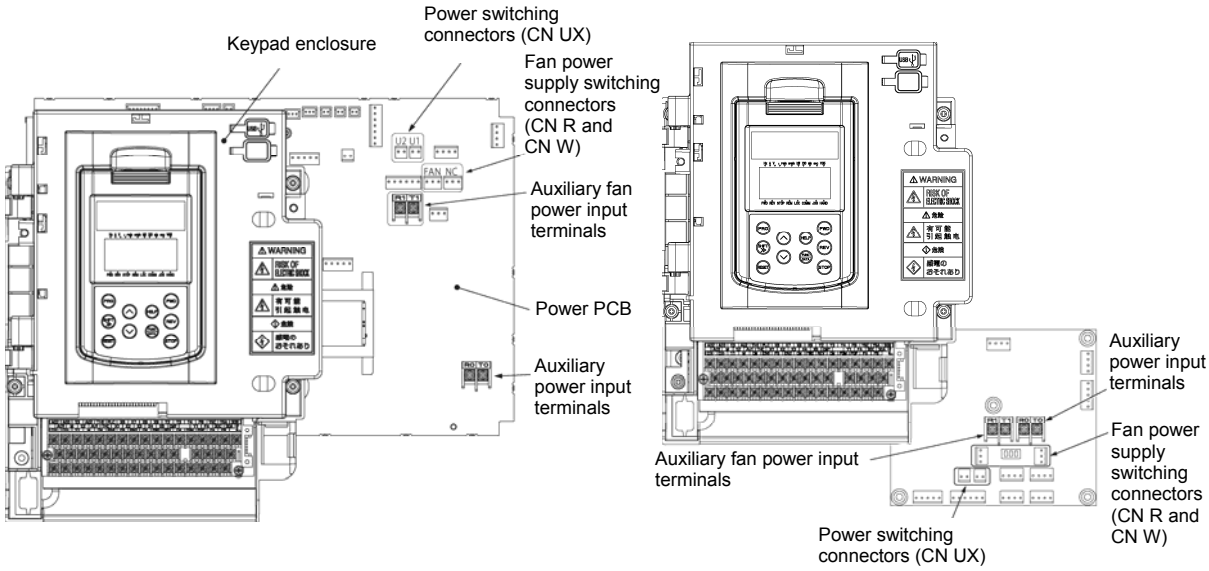

Figure 2.2-13 Wiring Route and Fixing Position for the Control Circuit Wires

Note
- Route the wiring of the control circuit terminals as far from the wiring of the main circuit as possible. Otherwise electric noise may cause malfunctions.
- Fix the control circuit wires with a cable tie inside the inverter to keep them away from the live parts of the main circuit (such as the terminal block of the main circuit).

### 2.2.7 Switching connectors

■ Location of the switching connectors

The switching connectors are located on the power printed circuit board (power PCB) as shown below.




(a) FRN37VG1□-2□ to FRN75VG1□-2□, FRN75VG1□-4□ to FRN110VG1□-4□

(b) FRN90VG1□-2□, FRN132VG1□-4□ to FRN630VG1□-4□

Figure 2.2-14 Location of Switching Connectors and Auxiliary Power Input Terminals

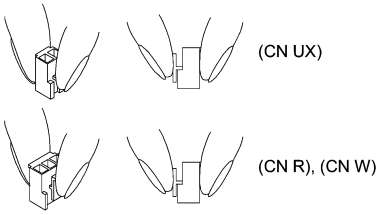



Figure 2.2-15 Inserting/Removing the Jumpers

Note To remove each of the jumpers, pinch its upper side between your fingers, unlock its fastener, and pull it up.

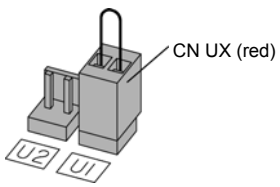
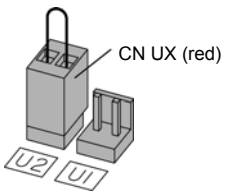
When mounting it, fit the jumper over the connector until it snaps into place.

■ Power switching connectors (CN UX), for inverters of 75 kW or above (400 V class series)

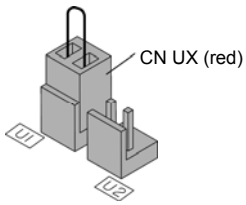
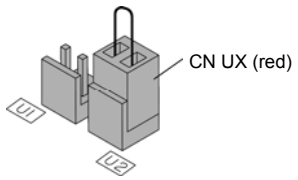
Inverters of 75 kW or above (400 V class series) are equipped with a set of switching connectors (male) which should be configured according to the power source voltage and frequency. By factory default, a jumper (female connector) is set to U1. If the power supply to the main power inputs (L1/R, L2/S, L3/T) or the auxiliary fan power input terminals (R1, T1) matches the conditions listed below, change the jumper to U2.

For the switching instructions, see Figure 2.2-14 and Figure 2.2-15.

(a) FRN75VG1□-4□ to FRN110VG1□-4□

| | | |
|---|---|---|
| Connector configuration |  |  |
| Power source voltage | 398 to 440 V/50 Hz, 430 to 480 V/60 Hz (Factory default) | 380 to 398 V/50 Hz<br>380 to 430 V/60 Hz |

(b) FRN132VG1☐-4☐ to FRN630VG1☐-4☐

| | | |
|---|---|---|
| Connector configuration |  |  |
| Power source voltage | 398 to 440 V/50 Hz, 430 to 480 V/60 Hz<br>(Factory default) | 380 to 398 V/50 Hz,<br>380 to 430 V/60 Hz |

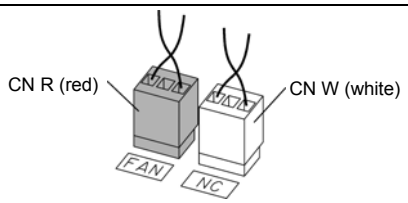
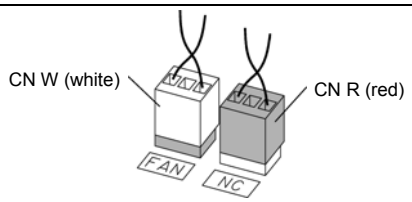
Note The allowable power input voltage fluctuation is within -15% to +10% of the power source voltage.

## ■ Fan power supply switching connectors (CN R and CN W), for inverters of 37 kW or above (200 V class series) and those of 75 kW or above (400 V class series)

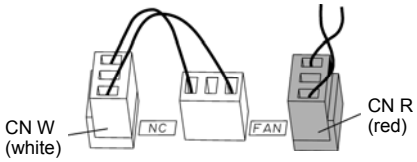
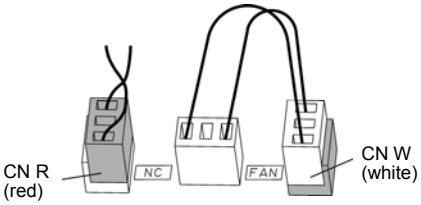
The standard FRENIC-VG series accepts DC-linked power input in combination with a PWM converter. The 200 V class series with 37 kW or above and 400 V class series with 75 kW or above, however, contain AC-driven components such as AC fans. To supply AC power to those components, exchange the CN R and CN W connectors as shown below and connect the AC power line to the auxiliary fan power input terminals (R1, T1).

For the switching instructions, see Figure 2.2-14 and Figure 2.2-15.

(a) FRN37VG1☐-2☐ to FRN75VG1☐-2☐, FRN75VG1☐-4☐ to FRN110VG1☐-4☐

| | | |
|---|---|---|
| Connector configuration |  |  |
| Use conditions | When not using terminal R1 or T1<br>(Factory default) | When using terminals R1 and T1<br>• Feeding the DC-linked power<br>• Combined with a PWM converter |

(b) FRN90VG1☐-2☐, FRN132VG1☐-4☐ to FRN630VG1☐-4☐

| | | |
|---|---|---|
| Connector configuration |  |  |
| Use conditions | When not using terminal R1 or T1<br>(Factory default) | When using terminals R1 and T1<br>• Feeding the DC-linked power<br>• Combined with a PWM converter |

Note By factory default, the fan power supply switching connectors CN R and CN W are set on the FAN and NC positions, respectively. Do not exchange them unless you drive the inverter with a DC-linked power supply.

Wrong configuration of these switching connectors cannot drive the cooling fans, causing a heat sink overheat alarm OH1 or a charger circuit alarm PbF.

### 2.2.8 Setting up the slide switches

**⚠WARNING⚠**

Before changing the switches or touching the control circuit terminal symbol plate, **turn OFF the power and wait at least five minutes for inverters of 22 kW or below, or at least ten minutes for those of 30 kW or above**. Make sure that the LED monitor and charging lamp are turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below).

**An electric shock may result if this warning is not heeded as there may be some residual electric charge in the DC bus capacitor even after the power has been turned OFF.**

Switching the slide switches located on the control PCB allows you to customize the operation mode of the analog output terminals, digital I/O terminals, and communications ports. The locations of those switches are shown in Figure 2.2-16 "Location of the Slide Switches on the Control PCB."

To access the slide switches, remove the front cover so that you can see the control PCB. For inverters with a capacity of 30 kW or above, open also the keypad enclosure.

For details on how to remove the front cover and how to open and close the keypad enclosure, refer to Section 2.2.2 "Removing and mounting the front cover and the wiring guide."

Figure 2.2-16 shows the location of slide switches on the control PCB for the input/output terminal configuration.

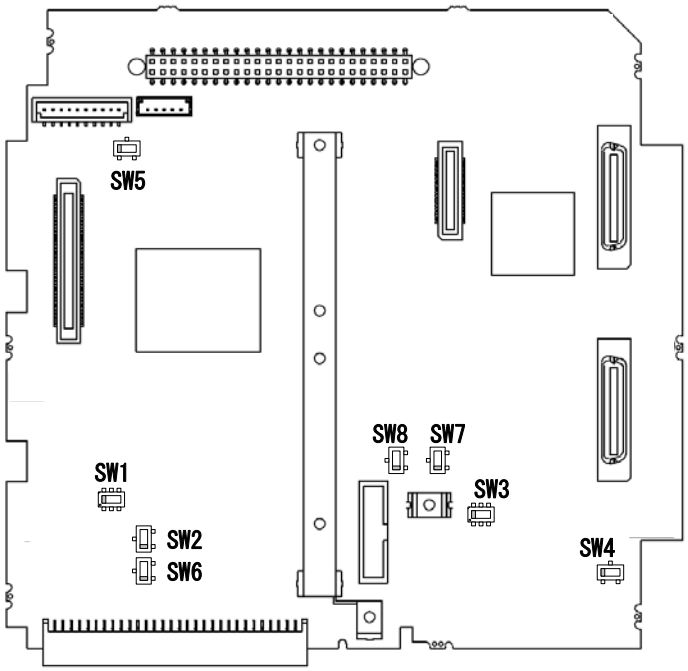



Figure 2.2-16 Location of the Slide Switches on the Control PCB

Switch Configuration and Factory Defaults

| | SW1 | SW2 | SW3 | SW4 | SW5 | SW6 | SW7<br>SW8 |
|---|---|---|---|---|---|---|---|
| Factory default | SINK | | V | OFF | | 15V | 1 |
| --- | SOURCE | | I | ON | | 12V | 2 |

Note To move a switch slider, use a tool with a narrow tip (e.g., a tip of tweezers). Be careful not to touch other electronic parts, etc. If the slider is in an ambiguous position, the circuit is unclear whether it is turned ON or OFF and the digital input remains in an undefined state. Be sure to place the slider so that it contacts either side of the switch.

SW2 and SW5 are reserved for particular manufacturers. Do not access them.

Table 2.2-6 lists function of each slide switch.

Table 2.2-6 Function of Each Slide Switch

<table>
<tr><th>Switch</th><th>Function</th></tr>
<tr><td>SW1</td><td>Switches the service mode of the digital input terminals between SINK and SOURCE.<br>▪ This switches the input mode of digital input terminals [X1] to [X9], [FWD] and [REV] to be used as the SINK or SOURCE mode.<br>▪ Factory default: SINK</td></tr>
<tr><td>SW2</td><td>Reserved for particular manufacturers.</td></tr>
<tr><td>SW3</td><td>Switches the input mode of the analog input terminal [Ai2] between voltage and current.
<table>
<tr><th>Input form</th><th>SW3</th></tr>
<tr><td>Voltage input (Factory default)</td><td>V position</td></tr>
<tr><td>Current input</td><td>I position</td></tr>
</table></td></tr>
<tr><td>SW4</td><td>Switches the terminating resistor of RS-485 communications port 2 on the terminal block ON and OFF. (RS-485 communications port 2, for connecting the keypad)<br>▪ If the inverter is connected to the RS-485 communications network as a terminating device, turn SW4 to ON.</td></tr>
<tr><td>SW5</td><td>Reserved for particular manufacturers.</td></tr>
<tr><td>SW6</td><td>Switches the output voltage of terminal [PGP] between 12 V and 15 V.<br>Select the voltage level that matches the power voltage of the pulse generator to be connected.
<table>
<tr><th>Output voltage</th><th>SW5</th></tr>
<tr><td>12 V</td><td>12 V</td></tr>
<tr><td>15 V (Factory default)</td><td>15 V</td></tr>
</table></td></tr>
<tr><td>SW7<br>SW8</td><td>Switch the output mode of terminals [FA] and [FB] between open collector output and complementary output.
<table>
<tr><th>Output form</th><th>SW7<br>(Terminal [FA])</th><th>SW8<br>(Terminal [FB])</th></tr>
<tr><td>Open collector output (Factory default)</td><td>1</td><td>1</td></tr>
<tr><td>Complementary output</td><td>2</td><td>2</td></tr>
</table></td></tr>
</table>

## 2.3 Mounting and Connecting a Keypad

### 2.3.1 Parts required for connection

To mount a keypad on a place other than an inverter, the parts listed below are needed.

| Parts name | Model | Remarks |
|---|---|---|
| Extension cable (Note 1) | CB-5S, CB-3S and CB-1S | 3 types available in length of 5 m, 3 m, and 1 m. |
| Fixing screw | M3 × □ (Note 2) | Two screws needed. (To be provided by the customer) |

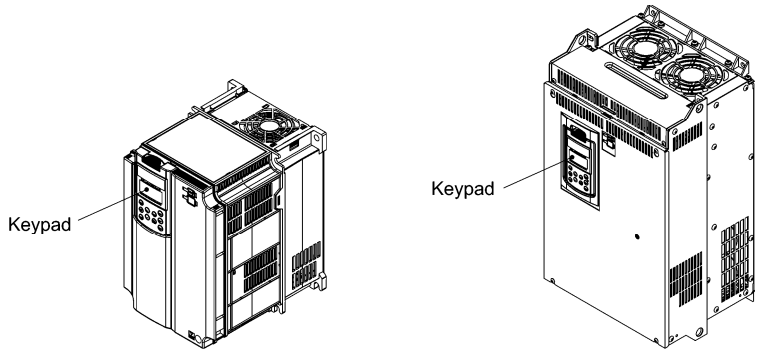
(Note 1) When using an off-the-shelf LAN cable, use a 10BASE-T/100BASE-TX straight type cable compliant with US ANSI/TIA/EIA-568A Category 5. (20 m or less)
Recommended LAN cable
Manufacturer: Sanwa Supply Inc.
Model: KB-10T5-01K (1 m)
KB-STP-01K: (1 m) (Shielded LAN cable to make the inverter compliant with the EMC Directive)

(Note 2) When mounting on a panel wall, use the screws with a length suitable for the wall thickness.

### 2.3.2 Mounting procedure

You can install and/or use the keypad in one of the following three ways:

- Mounting it directly on the inverter (see Figure 2.3-1 (a), (b))
- Mounting it on the panel (see Figure 2.3-2).
- Using it remotely in your hand (see Figure 2.3-3).




(a) FRN15VG1□-2□ (b) FRN37VG1□-2□

Figure 2.3-1 Mounting the Keypad Directly on the Inverter

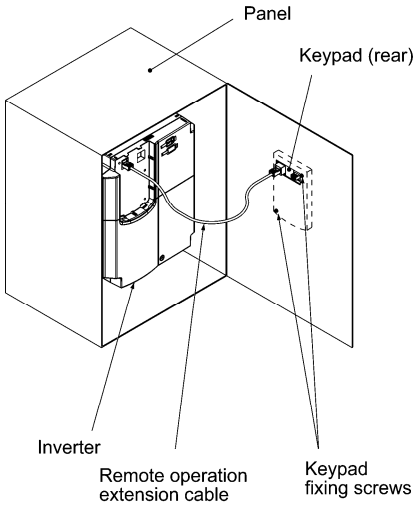



Figure 2.3-2 Mounting the Keypad on the Panel

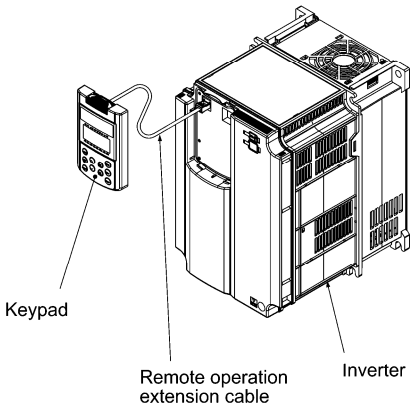



Figure 2.3-3 Using the Keypad Remotely in Your Hand

After completion of wiring, mount the keypad using the following procedure. Make sure that the inverter power is shut down beforehand.

■ Mounting the keypad directly on the inverter

(1) Remove the keypad by pulling it toward you with the hook held down as directed by the arrows in Figure 2.3-4.

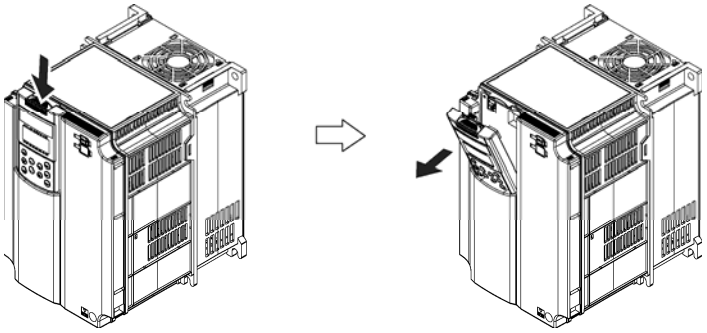


Figure 2.3-4 Removing a Keypad

(2) Put the keypad in the original slot while engaging its bottom latches with the holes (as shown below), and push it onto the case of the inverter (arrow ②) while holding it downward (against the terminal block cover) (arrow ①).

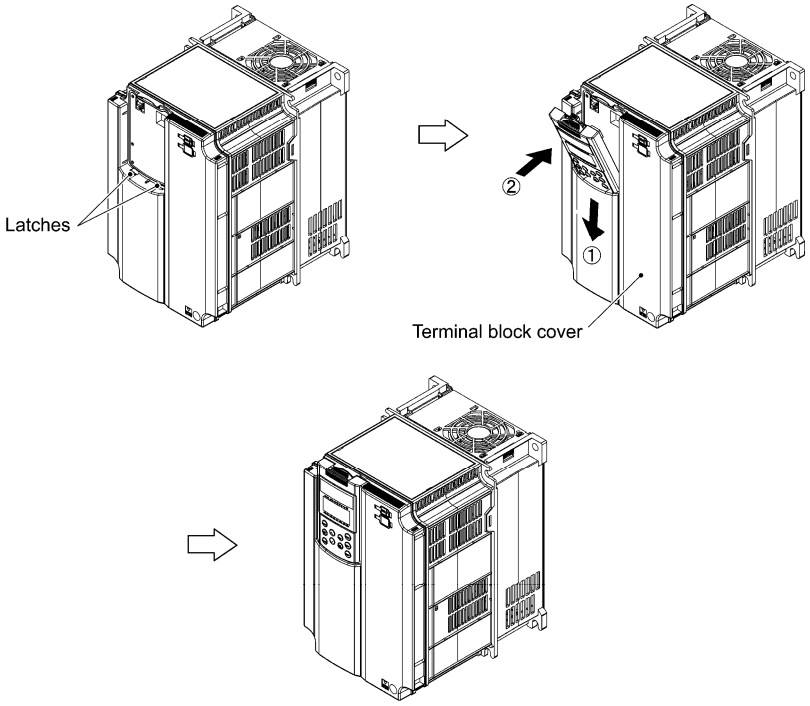



Figure 2.3-5 Mounting the Keypad

■ Mounting the keypad on the panel

(1) Cut the panel out for a single square area and perforate two screw holes on the panel wall as shown in Figure 2.3-6.

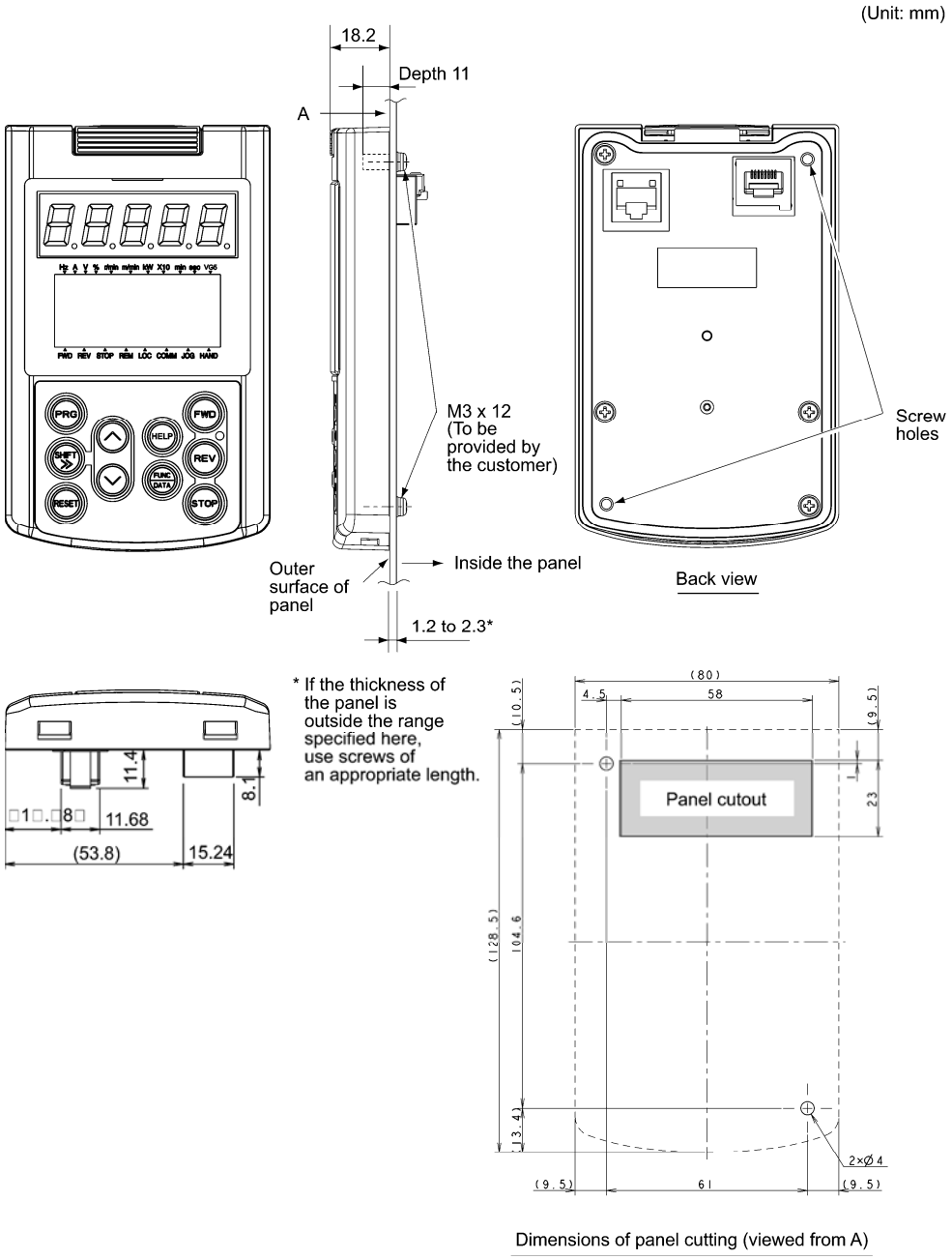



Figure 2.3-6 Location of Screw Holes and Dimension of Panel Cutout

(2) Mount the keypad on the panel wall with 2 screws as shown below. (Recommended tightening torque: 0.7 N•m)

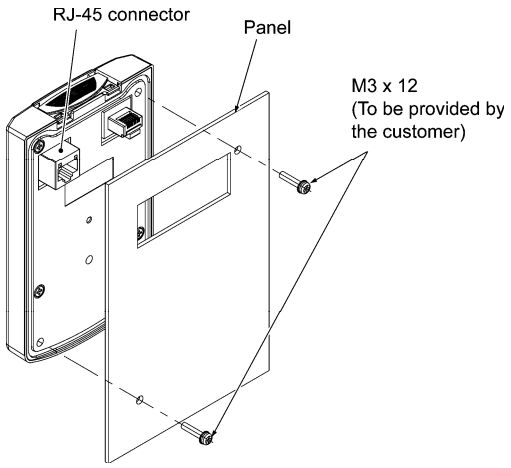



Figure 2.3-7 Mounting the Keypad

(3) Using a remote operation extension cable or a LAN cable, interconnect the keypad and the inverter (insert one end of the cable into the RS-485 port with RJ-45 connector on the keypad and the other end into that on the inverter) (See Figure 2.3-8).

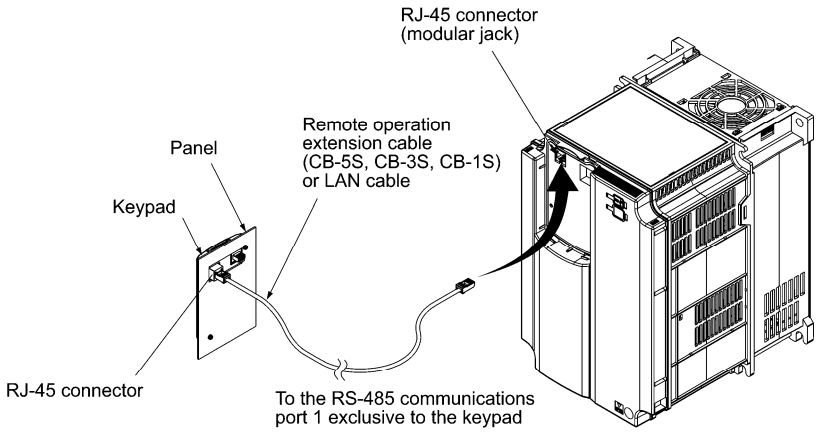



Figure 2.3-8 Connecting the Keypad to the Inverter with Remote Operation Extension Cable or an Off-the-shelf LAN Cable

## ⚠CAUTION

- The RJ-45 connector on the inverter is exclusive to communication via a touch panel. With the RJ-45 connector, neither RS-485 communication nor connection with FRENIC-VG Loader is possible.
- Do not connect the inverter to a LAN port of a computer, Ethernet hub, or telephone line. Doing so may damage the inverter or devices connected.

**A fire or accident could occur.**

■ Using the keypad remotely in hand

Follow step (3) of "Mounting the keypad on the panel" above.

## 2.4 USB Connectivity

At the right side of the keypad mounting place, a USB port (mini B connector) is provided. To connect a USB cable, open the USB port cover as shown below.

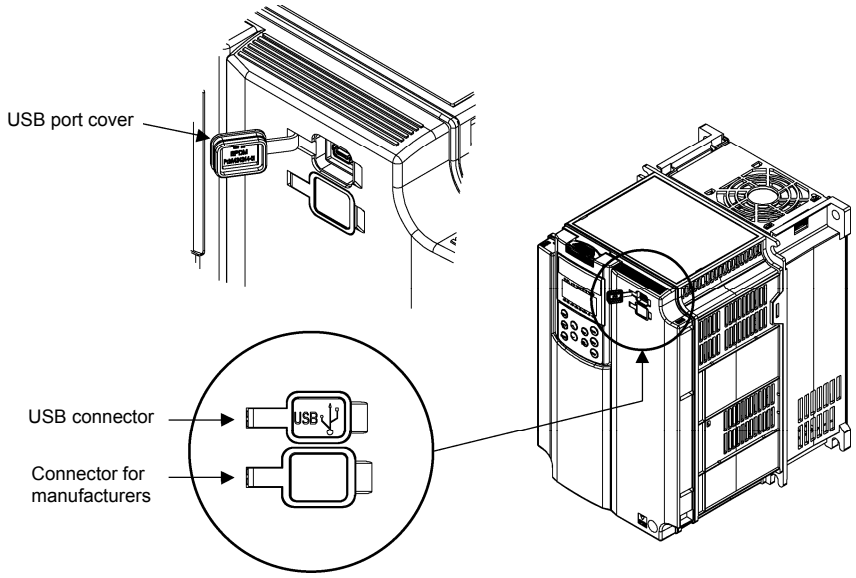



Figure 2.4-1 Connecting a USB Cable

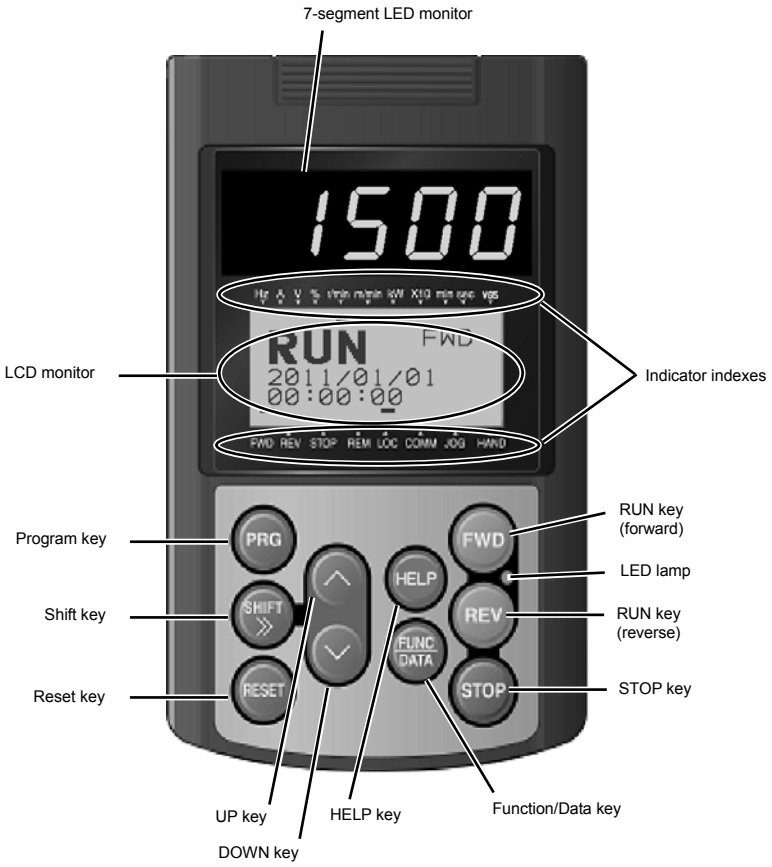
Connecting the inverter to a PC with a USB cable enables remote control from FRENIC-VG Loader. On the PC running FRENIC-VG Loader, it is possible to edit, check and manage the inverter's function code data and monitor the real-time data and the running/alarm status of the inverter.

| ⚠CAUTION |
| --- |
| Connector located beneath the USB connector is provided for particular manufacturers. Do not access it.<br>**Otherwise, a fire or accident could occur.** |

# Chapter 3 OPERATION USING THE KEYPAD

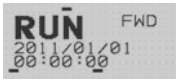
## 3.1 Names and Functions of Keypad Components

The keypad allows you to start and stop the motor, view various data including maintenance information and alarm information, configure function codes, monitor I/O signal status, copy data, and calculate the load factor.

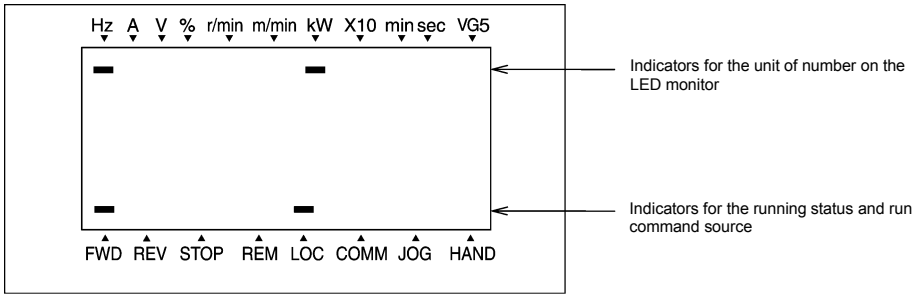



📖 For details, refer to the FRENIC-VG User's Manual Chapter 3, Section 3.4 "OPERATION USING THE KEYPAD".

Table 3.1-1 Overview of Keypad Functions

| Item | Monitors and Keys | Functions |
|---|---|---|
| Monitors | | Five-digit, 7-segment LED monitor which displays the following according to the operation modes:<br>■ In Running mode: Running status information (e.g., detected speed, speed command, and torque command)<br>■ In Programming mode: Same as above.<br>■ In Alarm mode: Alarm code, which identifies the cause of alarm when the protective function is activated. |
| |  | LCD monitor which displays the following according to the operation modes:<br>■ In Running mode: Running status information<br>■ In Programming mode: Menus, function codes and their data<br>■ In Alarm mode: Alarm information, which identifies the cause of an alarm when the protective function is activated. |
| | Indicator indexes | In Running mode, these indexes show the unit of the number displayed on the 7-segment LED monitor and the running status information on the LCD monitor. For details, see the next page. |
| Programming keys | PRG | Switches the operation modes of the inverter. |
| | SHIFT | Shifts the cursor to the right for entry of a numerical value. |
| | RESET | Pressing this key after removing the cause of an alarm switches the inverter to Running mode.<br>This key is used to reset settings or screen transition. |
| | ∧ / ∨ | UP and DOWN keys, which are used to select the setting items or change function code data. |
| | FUNC DATA | Function/Data key, which switches the operation mode as follows:<br>■ In Running mode: Pressing this key switches the information to be displayed concerning the status of the inverter (detected speed, speed command, torque command, etc.).<br>■ In Programming mode: Pressing this key displays the function code and establishes the newly entered data.<br>■ In Alarm mode: Pressing this key displays the details of the problem indicated by the alarm code that has come up on the LED monitor. |
| | STOP + ∧ | This simultaneous keying toggles between the ordinary running mode and jogging mode.<br>The current mode appears on the corresponding indicator. |
| | STOP + RESET | This simultaneous keying toggles between the remote and local modes.<br>The current mode appears on the corresponding indicator. |
| | SHIFT + ∧ / ∨ | This simultaneous keying jumps the cursor to the preceding/following function code group (F to M) in selecting a function code. |
| Operation keys | FWD | Starts running the motor in the forward rotation. |
| | REV | Starts running the motor in the reverse rotation. |
| | STOP | Stops the motor. |
| | HELP | Switches the screen to the operation guide display prepared for each operation mode or to the menu function guide display. |
| LED lamp | FWD LED REV | Lights when the inverter is running. |

**Details of Indicator Indexes**




| Type | Item | Description (information, condition, status) |
|---|---|---|
| Unit of number on LED monitor | Hz | Output frequency |
| | A | Output current |
| | V | Output voltage |
| | % | Torque command, calculated torque, and load factor |
| | kW | Input power and motor output |
| | r/min | Preset and actual (detected) motor speeds |
| | m/min | Preset and actual line speeds |
| | X10 | Data exceeding 99,999 |
| | min | Not used. |
| | sec | Not used. |
| | VG5 | Not used. |
| Running status | FWD | Running in forward rotation |
| | REV | Running in reverse rotation |
| | STOP | No output |
| Run command source | REM | Remote mode (Run command and speed command sources selected by F02 and F01)<br>(In the remote mode, a run command entered via the communications link takes effect. This indicator goes off when H30 = 2 or 3.) |
| | LOC | Local mode (Run command and speed command sources from the keypad, independent of the setting of F02 and F01.) |
| | COMM | Via communications link |
| | JOG | Jogging mode |
| | HAND | Via keypad<br>This indicator lights also:<br>- in local mode or<br>- in remote mode and when H30 = 0 and F02 = 0 |

## 3.2 Programming Mode

Programming mode allows you to set and check function code data and monitor maintenance information and input/output (I/O) signal status. The functions can be easily selected with a menu-driven system. Table 3.2-1 lists menus available in Programming mode.

Table 3.2-1 Menus Available in Programming Mode

| Menu # | Menu | Used to: |
|---|---|---|
| 0 | Selecting language (LANGUAGE) | Change the display language on the LCD monitor. |
| 1 | Configuring function codes (DATA SET) | Display and change the data of the function code selected. |
| 2 | Checking function code data (DATA CHECK) | Display a function code and its data on the same screen. Also this menu is used to change the function code data or check whether the data has been changed from the factory default. |
| 3 | Monitoring the running status (OPR MNTR) | Display the running information required for maintenance or test running. |
| 4 | Checking I/O signal status (I/O CHECK) | Display external interface information. |
| 5 | Reading maintenance information (MAINTENANCE) | Display maintenance information including cumulative run time. |
| 6 | Measuring load factor (LOAD FCTR) | Measure the maximum output current, average output current, and average braking power. |
| 7 | Reading alarm information (ALM INF) | Display recent four alarm codes. Also this menu is used to view the information on the running status at the time the alarm occurred. |
| 8 | Viewing causes of alarm (ALM CAUSE) | Display the cause of the alarm. |
| 9 | Reading communications information (COMM INFO) | (Available soon.) |
| 10 | Copying data (DATA COPY) | Read or write function code data, as well as verifying it. |
| 11 | Checking changed function codes (CHANGES) | Display only the function code data that has been changed from the factory default. |
| 12 | Setting the calendar clock (DATE/TIME) | Display/hide the date and time and adjust the display format and data. |
| 13 | Compatibility with conventional inverter models (MODE SEL) | Not supported. |
| 14 | Limiting function codes to be displayed (LIMITED FC) | • Select whether to display all function codes or limited ones (selected in Loader).<br>• Cancel the directory structure of function codes. |

### ■ Configuring function code data

Figure 3.2-1 shows the LCD screen transition for Menu #0 "DATA SET."

A hierarchy exists among those screens that are shifted in the order of "Menu screen," "List of function code groups," and "List of function codes." On the modification screen of the target function code, you can modify or check its data.

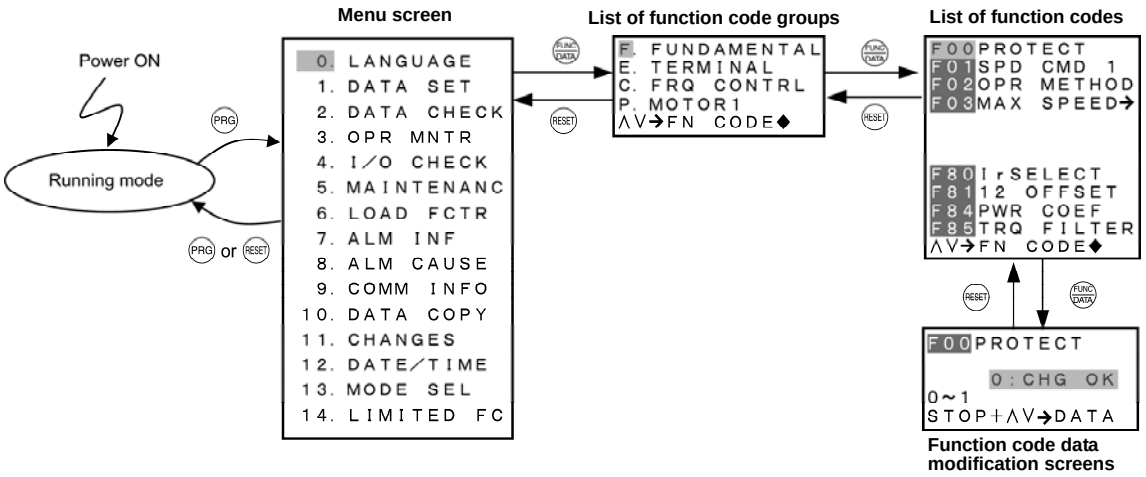
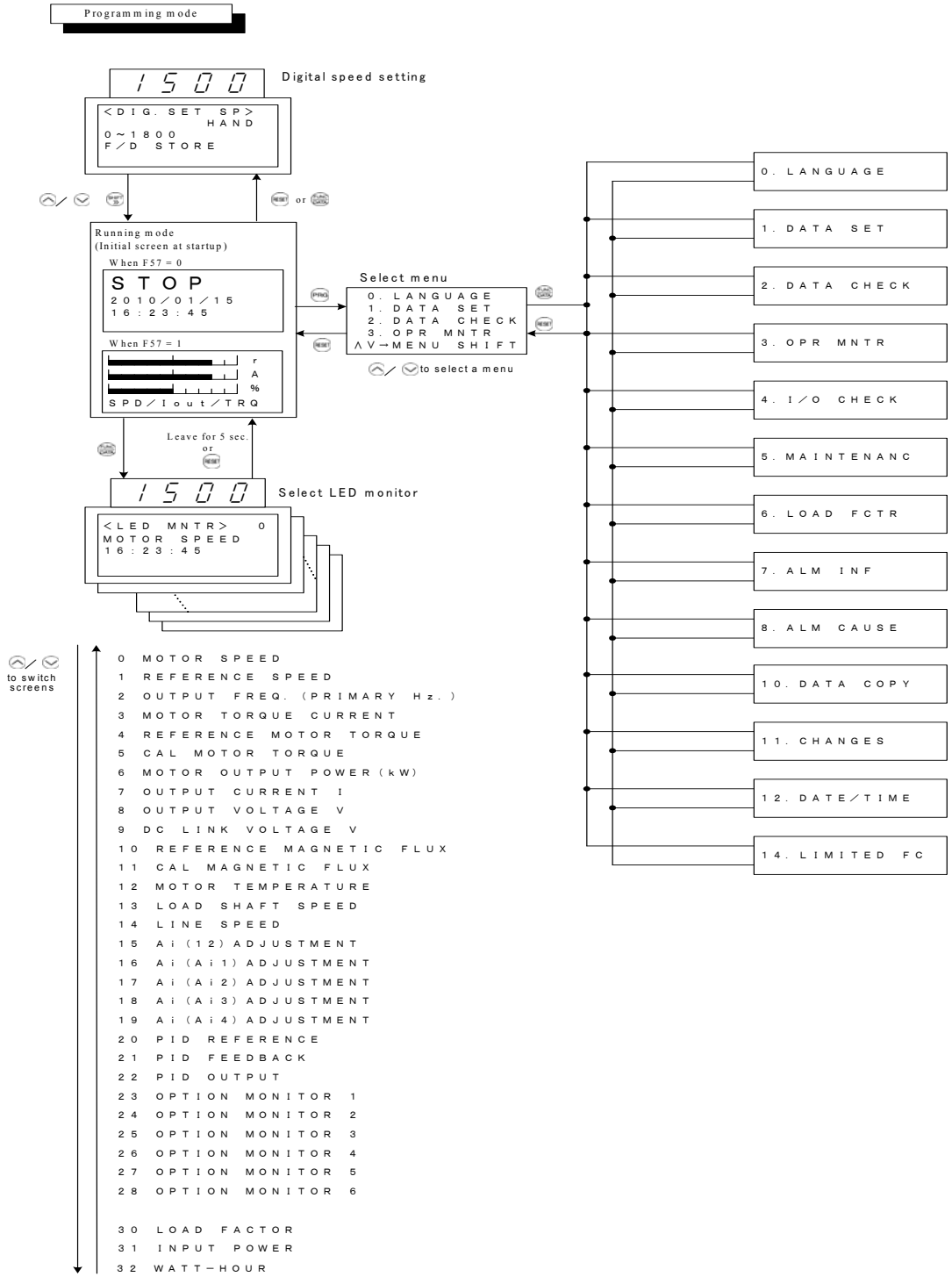



Figure 3.2-1 Configuration of Screens for "DATA SET"

The screen transition and hierarchy structure in Running and Programming modes are shown below.



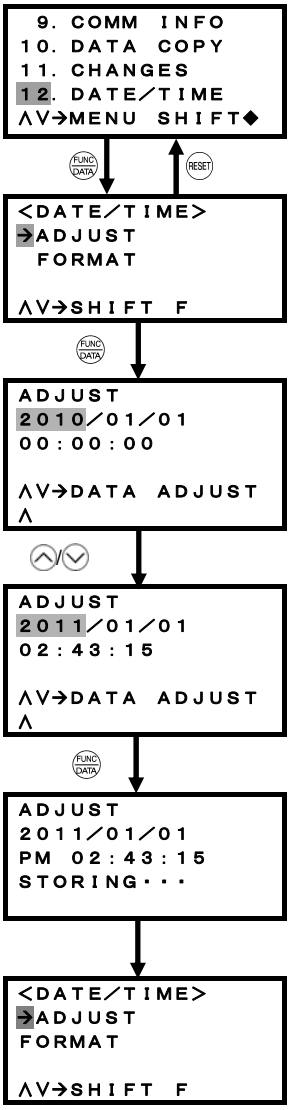

* If the screen system is password-protected, no menu can be selected until you enter the password.

### 3.2.1 **Setting the calendar clock** -- Menu #12 "DATE/TIME"

Menu #12 "DATE/TIME" in Programming mode is used to select the format of the calendar clock to be displayed in the operation guide line in Running mode and set the date and time.

| ⚠CAUTION |
|---|
| After mounting a memory backup battery (option for inverters of 22 kW or below, attached as standard for those of 33 kW or above), set the date and time. When a memory backup battery is not mounted, the calendar clock does not work correctly. |

1) Setting the date and time




To display this menu screen, press the PRG key in Running mode to switch to Programming mode.

Move the cursor (flashing rectangle) at the left of the screen to "12. DATA/TIME" using the ∧ and ∨ keys. Then press the FUNC/DATA key.

Move the cursor (flashing rectangle) at the left of the screen to "ADJUST" using the ∧ and ∨ keys. Then press the FUNC/DATA key.

Use the SHIFT key to move the cursor to the desired item.

Change the date and time using the ∧ and ∨ keys.

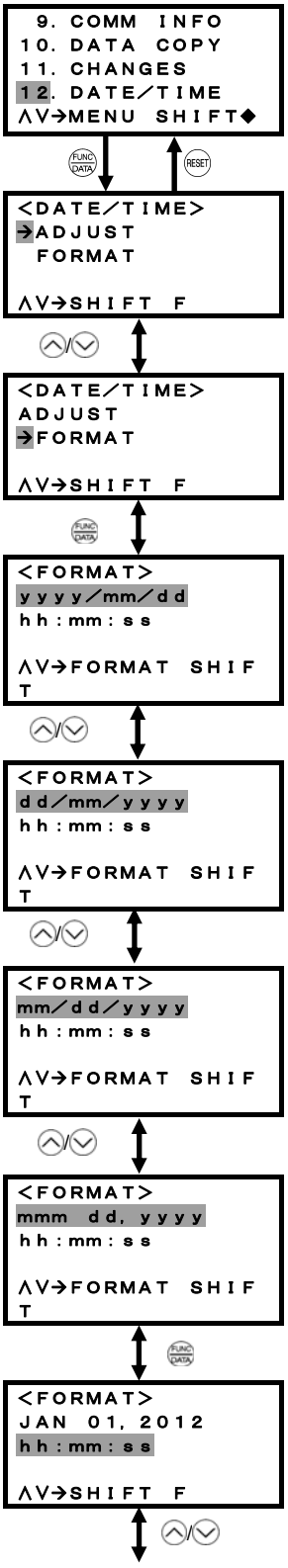
Press FUNC/DATA key to establish the date and time.

If the relationship between the changed year, month, day, and time is invalid, "CANNOT SET" appears when the FUNC/DATA key is pressed.

After a second, the screen automatically switches back to the submenu.

Tip The calendar clock can also be set with FRENIC-VG Loader. For details, refer to the FRENIC-VG Loader Instruction Manual.

2) Selecting the display format




To display this menu screen, press the PRG key in Running mode to switch to Programming mode.

Move the cursor (flashing rectangle) at the left of the screen to "12. DATA/TIME" using the ∧ and ∨ keys. Then press the FUNC DATA key.

Press FUNC DATA key to establish the desired menu.

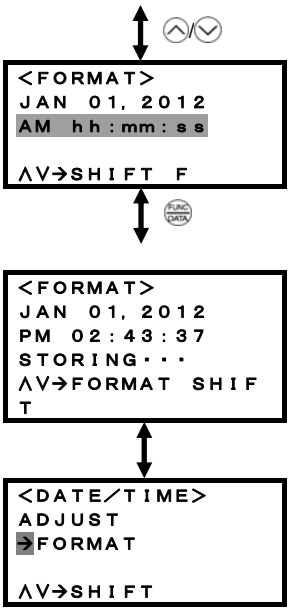
Move the cursor (flashing rectangle) at the left of the screen to "FORMAT" using the ∧ and ∨ keys. Then press the FUNC DATA key.

Change the date format data using the ∧ and ∨ keys.

<List of date formats>

| | |
|---|---|
| yyyy/mm/dd | Year/Month/Date |
| dd/mm/yyyy | Date/Month/Year |
| mm/dd/yyyy | Month/Date/Year |
| mmm dd, yyyy | Month Date, Year |
| <OFF> | No display |

Press FUNC DATA key to establish the newly specified date format.




Change the time format data using the ∧ and ∨ keys.

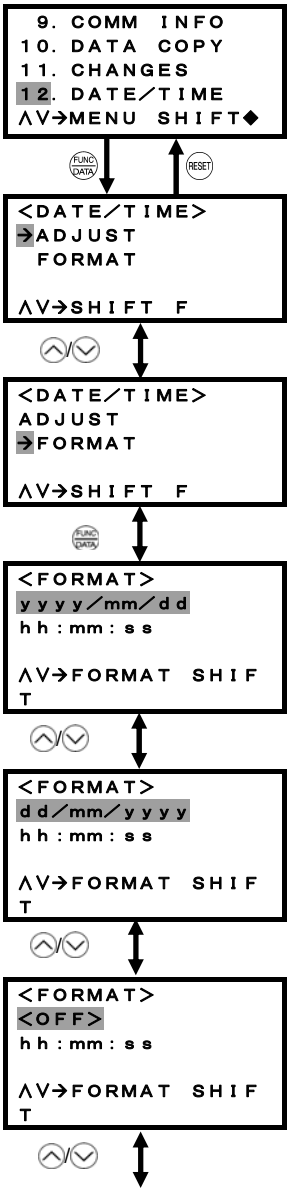
<List of time formats>

| | |
|---|---|
| hh:mm:ss | 0-24 hour: minutes: seconds |
| hh:mm:ss AM | 0-12 hour: minutes: seconds AM/PM |
| AM hh:mm:ss | AM/PM 0-12 hour: minutes: seconds |
| <OFF> | No display |

Press FUNC/DATA key to establish the newly specified time format.

After a second, the screen automatically switches back to the submenu.

3) Selecting the No display




To display this menu screen, press the PRG key in Running mode to switch to Programming mode.
Move the cursor (flashing rectangle) at the left of the screen to "12. DATA/TIME" using the ∧ and ∨ keys. Then press the FUNC/DATA key.

Press FUNC/DATA key to establish the desired menu.

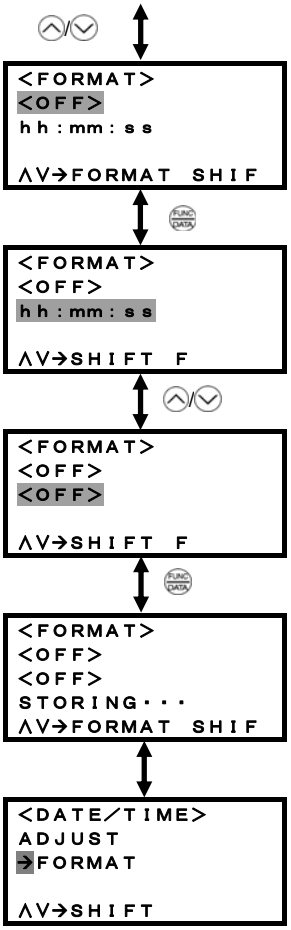
Move the cursor (flashing rectangle) at the left of the screen to "FORMAT" using the ∧ and ∨ keys. Then press the FUNC/DATA key.

Change the date format data using the ∧ and ∨ keys.

<List of date formats>

| | |
|---|---|
| yyyy/mm/dd | Year/Month/Date |
| dd/mm/yyyy | Date/Month/Year |
| mm/dd/yyyy | Month/Date/Year |
| mmm dd, yyyy | Month Date, Year |
| <OFF> | No display |

Move the cursor (flashing rectangle) at the left of the screen to "<OFF>" using the ∧ and ∨ keys. Then press the FUNC/DATA key.




Press FUNC DATA key to establish the newly specified date format.

Change the time format data using the ∧ and ∨ keys.

<List of time formats>

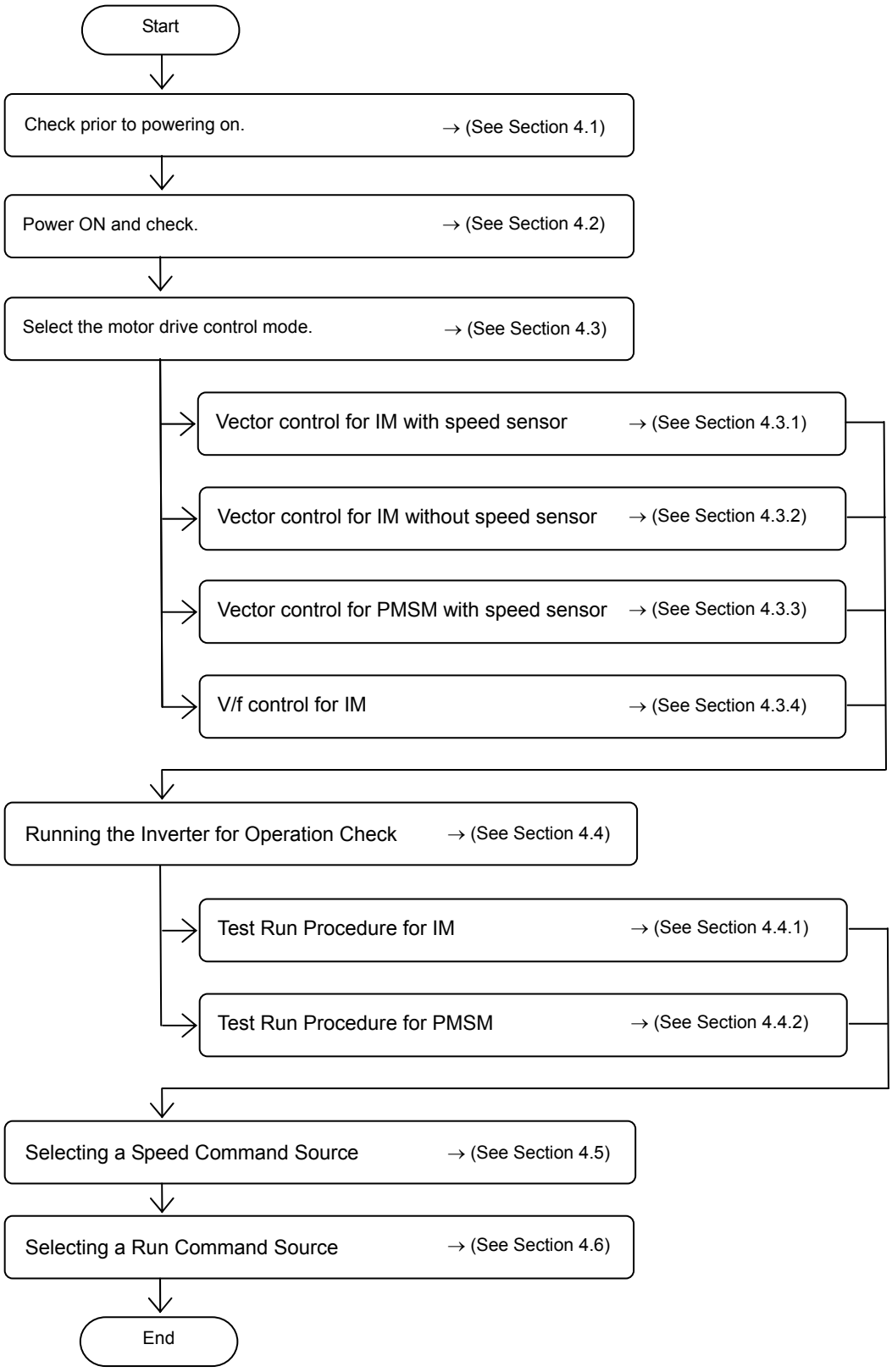
| | |
|---|---|
| hh:mm:ss | 0-24 hour: minutes: seconds |
| hh:mm:ss AM | 0-12 hour: minutes: seconds AM/PM |
| AM hh:mm:ss | AM/PM 0-12 hour: minutes: seconds |
| <OFF> | No display |

Move the cursor (flashing rectangle) at the left of the screen to "<OFF>" using the ∧ and ∨ keys. Then press the FUNC DATA key.

After a second, the screen automatically switches back to the submenu.

## Chapter 4 TEST RUN PROCEDURE

Make a test run of the motor using the flowchart given below.



## 4.1 Checking Prior to Powering On

Check the following before powering on the inverter.

(1) Check the wiring to the inverter input terminals L1/R, L2/S and L3/T and output terminals U, V, and W. Also check that the grounding wires are connected to the grounding terminals (⏚G) correctly. (See Figure 4.1-1.)

**⚠WARNING**

- Never connect power supply wires to the inverter output terminals U, V, and W. Doing so and turning the power ON breaks the inverter.
- Be sure to connect the grounding wires of the inverter and the motor to the ground electrodes.

**Otherwise, an electric shock could occur.**

(2) Check the control circuit terminals and main circuit terminals for short circuits or ground faults.

(3) Check for loose terminals, connectors and screws.

(4) Check that the motor is separated from mechanical equipment.

(5) Make sure that all switches of devices connected to the inverter are turned OFF. Powering on the inverter with any of those switches being ON may cause an unexpected motor operation.

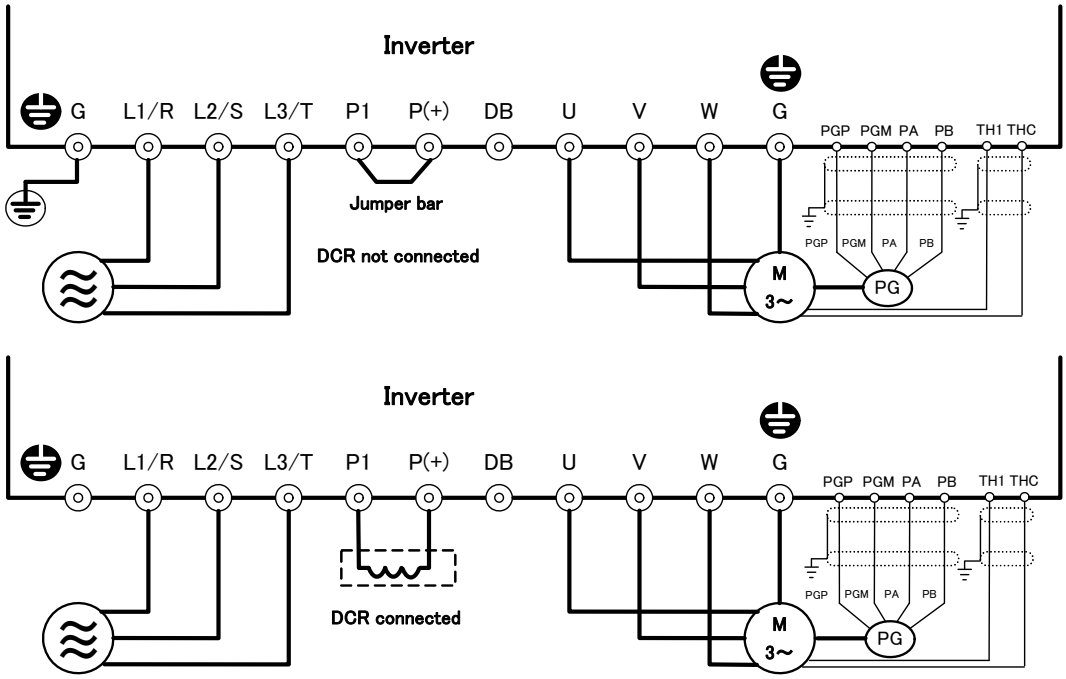
(6) Check that safety measures are taken against runaway of the equipment, e.g., a defense to prevent people from access to the equipment.

(7) Check that a power factor correction DC reactor (DCR) is connected to terminals P1 and P(+).
(Inverters of 55 kW in LD mode and inverters of 75 kW or above are provided together with a DCR as standard. Be sure to connect the DCR to the inverter.)

(8) Check that the PG (pulse generator) wiring is correct.

**⚠CAUTION**

Wrong wiring may break the PG..
If the inverter is powered on with wrong wiring, disconnect the PG signal wires from the inverter, keep only the PG powered on via the PGP and PGM, and then check that each signal is correctly output with an oscilloscope or recorder.




**Note:** In principle, the shielded sheath of wires should be connected to ground. If the inverter is significantly affected by external induction noise, however, connection to 0V may be effective to suppress the influence of noise.

Figure 4.1-1 Connection of Main Circuit Terminals (Vector dedicated motor connected)

## 4.2 Powering ON and Checking

**⚠WARNING**

- Be sure to mount the front cover before turning the power ON. Do not remove the cover when the inverter power is ON.
- Do not operate switches with wet hands.
  **Otherwise, an electric shock could occur.**

Turn the power ON and check the following points. The following is a case when no function code data is changed from the factory defaults.

(1) Check that the LED monitor displays 0 (indicating that the reference speed is 0 r/min) that is blinking. (See Figure 4.2-1.)
If the LED monitor displays any number except 0, press ⌃ / ⌄ key to set 0.

(2) Check that the built-in cooling fans rotate.

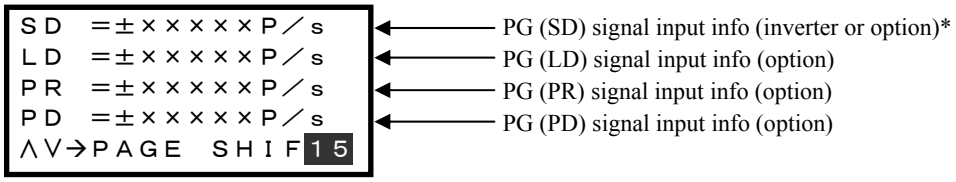
Figure 4.2-1 Display of the LED Monitor at Power-on

### 4.2.1 Checking the input state of PG (pulse generator) signals

Before proceeding to a test run of the inverter, rotate the motor shaft and check the digital input state of PG (pulse generator) signals on the screen shown below.

To call up the screen, switch the inverter operation mode from the Running mode to the Programming mode, select Menu #4 "I/O CHECK" on the menu screen, and select page 15 (shown below) using the ⌃/⌄ keys.

For detailed operation procedure, refer to the FRENIC-VG User's Manual Chapter 3, Section 3.4.4.5.




* When a PG (SD) option is mounted, the PG (SD) signal input info appears; when it is not, the inverter PG signal input info appears.

### 4.2.2 Mounting direction of a PG (pulse generator) and PG signals

The forward rotational direction of the dedicated motor (MVK type) is CCW when viewed from the motor output shaft as shown in Figure 4.2-2.

During rotation in the forward direction, the PG output pulse forms a forward rotation signal (B phase advanced by 90 degrees) shown in Figure 4.2-3, and during rotation in the reverse direction, a reverse rotation signal (A phase advanced by 90 degrees).

When mounting an external PG on motors other than the dedicated one, directly connect it to the motor, using a coupling, etc.

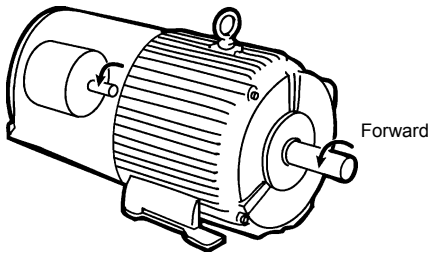



Figure 4.2-2 Forward Rotational Direction of Motor and PG

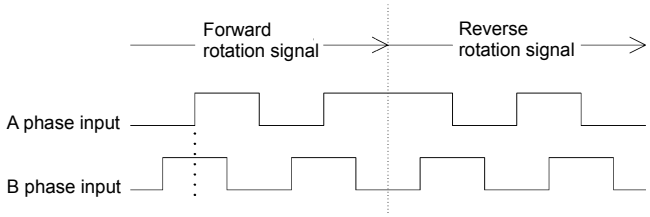



Figure 4.2-3 PG (Pulse Generator) Signal

## 4.3 Selecting a Desired Motor Drive Control

The FRENIC-VG supports the following motor drive controls.

| Data for P01 | M1 drive control | Speed feedback | Speed control | Refer to: |
|---|---|---|---|---|
| 0 | Vector control for IM with speed sensor | Yes | Speed control with automatic speed regulator (ASR) | Section 4.3.1 |
| 1 | Vector control for IM without speed sensor | Estimated speed | | Section 4.3.2 |
| 2 | Simulation mode | Yes | | FRENIC-VG User's Manual, Chapter 4, Section 4.3.4 "P codes" |
| 3 | Vector control for PMSM with speed sensor | Yes | | Section 4.3.3 |
| 5 | V/f control for IM | No | Frequency control | Section 4.3.4 |

### 4.3.1 Vector control for IM with speed sensor

Under vector control, the inverter detects the motor's rotational position and speed according to PG feedback signals and uses them for speed control. In addition, it decomposes the motor drive current into the exciting and torque current components, and controls each of components in vector.

The desired response can be obtained by adjusting the control constants (PI constants) with the speed regulator (PI controller).

This control enables the speed control with higher accuracy and quicker response than the vector control without speed sensor.

(A recommended motor for this control is a Fuji VG motor exclusively designed for vector control.)

Note Vector control regulating the motor current requires some voltage margin between the voltage that the inverter can output and the induced voltage of the motor. Usually a general-purpose motor is so designed that the voltage matches the commercial power. Under the control, therefore, it is necessary to suppress the motor terminal voltage to the lower level in order to secure the voltage margin required.

However, driving the motor with the motor terminal voltage suppressed to the lower level cannot generate the rated torque even if the rated current originally specified for the motor is applied. To ensure the rated torque, it is necessary to review the rated current. (This also applies to vector control without speed sensor.)

■ For Fuji VG motor exclusively designed for vector control

Configure the function codes as listed below. The machinery design values should match your machinery ones.

📖 For details on how to modify the function code data, refer to the FRENIC-VG User's Manual Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET". For details of the function code data, refer to the FRENIC-VG User's Manual Chapter 4, Section 4.3 "Details of Function Codes".

| Function code | Name | Function code data | Factory default |
|---|---|---|---|
| P01<br>A01<br>A101 | M1 Drive Control<br>M2 Drive Control<br>M3 Drive Control | 0: Vector control for IM with speed sensor | 0: Vector control for IM with speed sensor |
| P02 | M1 Selection | Motor to be applied | Motor to be applied |
| P28<br>A30<br>A130 | M1 PG Pulse Resolution<br>M2 PG Pulse Resolution<br>M3 PG Pulse Resolution | 1024 | 1024 |
| P30<br>A31<br>A131 | M1 Thermistor Type<br>M2 Thermistor Type<br>M3 Thermistor Type | 1: NTC thermistor | 1: NTC thermistor |
| F03 | M1 Maximum Speed<br>M2 Maximum Speed<br>M3 Maximum Speed | Machinery design values<br>**(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly. | 1500 r/min |
| F07 | Acceleration Time 1 **(Note)** | | 5.00 s |
| F08 | Deceleration Time 1 **(Note)** | | 5.00 s |

■ For motors except Fuji VG motor

To use motors except a Fuji VG motor when their motor parameters to be set to function codes are known, perform auto-tuning to automatically configure them.

Configure the function codes as listed below according to the motor ratings and your machinery design values. The motor ratings are printed on the motor's nameplate. For your machinery design values, ask system designers about them.

After configuring the function codes, perform motor parameter auto-tuning (H01 = 3 or 4).

📖 For details on how to modify the function code data, refer to the FRENIC-VG User's Manual Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET". For details of the function code data, refer to the FRENIC-VG User's Manual Chapter 4, Section 4.3 "Details of Function Codes".

| Function code | Name | Function code data | Factory default |
|---|---|---|---|
| P01<br>A01<br>A101 | M1 Drive Control<br>M2 Drive Control<br>M3 Drive Control | 0: Vector control for IM with speed sensor | 0: Vector control for IM with speed sensor |
| P02 | M1 Selection | 37: Others<br>(No modification is required for M2 or M3.) | Motor to be applied |
| P28<br>A30<br>A130 | M1 Pulse Resolution<br>M2 Pulse Resolution<br>M3 Pulse Resolution | Match the specifications of the PG to be used. | 1024 |
| P30<br>A31<br>A131 | M1 Thermistor Type<br>M2 Thermistor Type<br>M3 Thermistor Type | 0: No thermistor | 1: NTC thermistor |
| F04<br>A05<br>A105 | M1 Rated Speed<br>M2 Rated Speed<br>M3 Rated Speed | Motor ratings<br>(printed on the nameplate of the motor) | 1500 r/min |
| F05 | M1 Rated Voltage | | Rated voltage of nominal applied motors |
| A04<br>A104 | M2 Rated Voltage<br>M3 Rated Voltage | | 80 V |
| P03 | M1 Rated Capacity | | Capacity of nominal applied motors |
| A02<br>A102 | M2 Rated Capacity<br>M3 Rated Capacity | | 0.00 kW |
| P04 | M1 Rated Current | | Rated current of nominal applied motors |
| A03<br>A103 | M2 Rated Current<br>M3 Rated Current | | 0.01 A |
| P05<br>A07<br>A107 | M1 Poles<br>M2 Poles<br>M3 Poles | | 4 poles |
| F03<br>A06<br>A106 | M1 Maximum Speed<br>M2 Maximum Speed<br>M3 Maximum Speed | Machinery design values<br>**(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly. | 1500 r/min |
| F07 | Acceleration Time 1<br>**(Note)** | | 5.00 s |
| F08 | Deceleration Time 1<br>**(Note)** | | 5.00 s |

📖 For the motor parameter auto-tuning procedure (H01 = 3 or 4), refer to the FRENIC-VG User's Manual Chapter 4, Section 4.3.5 "H Codes (High performance Functions)."

| Function code | Name | Function code data | Factory default |
|---|---|---|---|
| H01 | Tuning Selection | 3: Auto tuning with motor stopped<br>4: Auto tuning with motor rotating | 0: Disable |

Note Performing motor parameter auto-tuning (H01 = 3 or 4) automatically changes the data of function codes P06 through P11 and P15 through P21 for M1, A08 through A13 and A17 through A23 for M2, and A108 through A113 and A117 through A123 for M3. Be careful with this data change.

After tuning, be sure to perform the full save function (H02 = 1) to save the tuned data into the inverter.

### 4.3.2 Vector control for IM without speed sensor

Under this control, the inverter estimates the motor speed based on the inverter's output voltage and current to use the estimated speed for speed control. In addition, it controls the motor current and motor torque with quick response and high accuracy under vector control. No PG (pulse generator) is required.

The desired response can be obtained by adjusting the control constants (PI constants) and using the speed regulator (PI controller).

Applying "vector control without speed sensor" requires auto-tuning regardless of the motor type. (Even driving a Fuji VG motor exclusively designed for vector control requires auto-tuning.)

Configure the function codes as listed below according to the motor ratings and your machinery design values. The motor ratings are printed on the motor's nameplate. For your machinery design values, ask system designers about them.

■ For Fuji VG motor exclusively designed for vector control

Configure the function codes as listed below and perform motor parameter auto-tuning (H01 = 2)

📖 For details on how to modify the function code data, refer to the FRENIC-VG User's Manual Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET". For details of the function code data, refer to the FRENIC-VG User's Manual Chapter 4, Section 4.3 "Details of Function Codes".

| Function code | Name | Function code data | Factory default |
|---|---|---|---|
| P01<br>A01<br>A101 | M1 Drive Control<br>M2 Drive Control<br>M3 Drive Control | 1: Vector control for IM without speed sensor | 0: Vector control for IM with speed sensor |
| P02 | M1 Selection | 37: Others<br>(No modification is required for M2 or M3.) | Motor to be applied |
| P30<br>A31<br>A131 | M1 PG Pulse Resolution<br>M2 PG Pulse Resolution<br>M3 PG Pulse Resolution | 1: NTC thermistor | 1: NTC thermistor |
| F03<br>A06<br>A106 | M1 Thermistor Type<br>M2 Thermistor Type<br>M3 Thermistor Type | Machinery design values<br>**(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly. | 1500 r/min |
| F07 | M1 Maximum Speed<br>M2 Maximum Speed<br>M3 Maximum Speed | | 5.00 s |
| F08 | Acceleration Time 1 **(Note)** | | 5.00 s |

📖 For the motor parameter auto-tuning procedure (H01 = 2), refer to the FRENIC-VG User's Manual Chapter 4, Section 4.3.5 "H Codes (High performance Functions)."

| Function code | Name | Function code data | Factory default |
|---|---|---|---|
| H01 | Tuning Selection | 2: Auto-tuning (R1, Lσ) | 0: Disable |

Note Performing motor parameter auto-tuning (H01 = 2) automatically changes the data of function codes P06 and P07 for M1, A08 and A09 for M2, and A108 and A109 for M3. Be careful with this data change.

After tuning, be sure to perform the full save function (H02 = 1) to save the tuned data into the inverter.

■ For motors except Fuji VG motor

Configure the function codes as listed below and perform motor parameter auto-tuning (H01 = 3 or 4)

📖 For details on how to modify the function code data, refer to the FRENIC-VG User's Manual Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET". For details of the function code data, refer to the FRENIC-VG User's Manual Chapter 4, Section 4.3 "Details of Function Codes".

| Function code | Name | Function code data | Factory default |
|---|---|---|---|
| P01<br>A01<br>A101 | M1 Drive Control<br>M2 Drive Control<br>M3 Drive Control | 1: Vector control for IM without speed sensor | 0: Vector control for IM with speed sensor |
| P02 | M1 Selection | 37: Others<br>(No modification is required for M2 or M3.) | Motor to be applied |
| P30<br>A31<br>A131 | M1 Thermistor Type<br>M2 Thermistor Type<br>M3 Thermistor Type | 0: No thermistor | 1: NTC thermistor |
| F04<br>A05<br>A105 | M1 Rated Speed<br>M2 Rated Speed<br>M3 Rated Speed | Motor ratings<br>(printed on the nameplate of the motor) | 1500 r/min |
| F05 | M1 Rated Voltage | | Rated voltage of nominal applied motors |
| A04<br>A104 | M2 Rated Voltage<br>M3 Rated Voltage | | 80 V |
| P03 | M1 Rated Capacity | | Capacity of nominal applied motors |
| A02<br>A102 | M2 Rated Capacity<br>M3 Rated Capacity | | 0.00 kW |
| P04 | M1 Rated Current | | Rated current of nominal applied motors |
| A03<br>A103 | M2 Rated Current<br>M3 Rated Current | | 0.01 A |
| P05<br>A07<br>A107 | M1 Poles<br>M2 Poles<br>M3 Poles | | 4 poles |
| F03<br>A06<br>A106 | M1 Maximum Speed<br>M2 Maximum Speed<br>M3 Maximum Speed | Machinery design values<br>**(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly. | 1500 r/min |
| F07 | Acceleration Time 1<br>**(Note)** | | 5.00 s |
| F08 | Deceleration Time 1<br>**(Note)** | | 5.00 s |

📖 For the motor parameter auto-tuning procedure (H01 = 3 or 4), refer to the FRENIC-VG User's Manual Chapter 4, Section 4.3.5 "H Codes (High performance Functions)."

| Function code | Name | Function code data | Factory default |
|---|---|---|---|
| H01 | Tuning Selection | 3: Auto tuning with motor stopped<br>4: Auto tuning with motor rotating | 0: Disable |

Note Performing motor parameter auto-tuning (H01 = 3 or 4) automatically changes the data of function codes P06 through P11 and P15 through P21 for M1, A08 through A13 and A17 through A23 for M2, and A108 through A113 and A117 through A123 for M3. Be careful with this data change.

After tuning, be sure to perform the full save function (H02 = 1) to save the tuned data into the inverter.

### 4.3.3 Vector control for PMSM with speed sensor and magnetic pole position sensor

Under this control, the inverter detects the motor's rotational position, speed and magnetic pole position according to feedback signals sent from the speed sensor and magnetic pole position sensor for speed control. In addition, it decomposes the motor drive current into the exciting and torque current components, and controls each of components in vector.

The desired response can be obtained by adjusting the control constants (PI constants) with the speed regulator (PI controller).

(A recommended motor for this control is Fuji GNF2 series exclusively designed for vector control.)

■ For Fuji GNF2 motor exclusively designed for vector control

Configure the function codes as listed below. The machinery design values should match your machinery ones. For details, contact your Fuji Electric representative.

📖 For details on how to modify the function code data, refer to the FRENIC-VG User's Manual Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET". For details of the function code data, refer to the FRENIC-VG User's Manual Chapter 4, Section 4.3 "Details of Function Codes".

| Function code | Name | Function code data | Factory default |
|---|---|---|---|
| P01<br>A01 | M1 Drive Control<br>M2 Drive Control | 3: Vector control for PMSM with speed sensor and magnetic pole position sensor | 0: Vector control for IM with speed sensor |
| A101 | M3 Drive Control | | 5: V/f control for IM |
| P02 | M1 Selection | 37: Others<br>(No modification is required for M2 or M3.) | Motor to be applied |
| o10<br>A60<br>A160 | M1 Magnetic Pole Position Sensor Offset<br>M2 Magnetic Pole Position Sensor Offset<br>M3 Magnetic Pole Position Sensor Offset | 0.0 to 359.9<br>(0.0° to 359.9° CCW)<br>Use the function code to adjust the magnetic pole position.<br>For detail, refer to pages 69 "[ 3 ] Setting the magnetic pole position sensor offset value". | 0.0 |
| o11<br>A61<br>A161 | M1 Saliency Ratio (%Xq/%Xd)<br>M2 Saliency Ratio (%Xq/%Xd)<br>M3 Saliency Ratio (%Xq/%Xd) | 1.000 to 3.000<br>Specify the saliency ratio of PMSM. | 1.000 |
| F03<br>A06<br>A106 | M1 Maximum Speed<br>M2 Maximum Speed<br>M3 Maximum Speed | Machinery design values<br>**(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly. | 1500 r/min |
| F07 | Acceleration time 1<br>**(Note)** | | 5.00 s |
| F08 | Deceleration time 1<br>**(Note)** | | 5.00 s |
| * For detail on function code that need to be configured other than the above, refer to Table 4.3-1 " Function code table 1 of Synchronous motor (GNF2)" and Table 4.3-2 " Function code table 2 of Synchronous motor (GNF2)". | | | |

Note Since vector control for a Fuji GNF2 motor with speed sensor uses motor parameters, the following conditions should be satisfied; otherwise, full control performance may not be obtained.

- A single motor should be connected per inverter.
- Motor parameters are properly configured.

Table 4.3-1 Function code table 1 of Synchronous motor (GNF2)

| Motor Type | Motor Capacity | Rated Voltage | Rated Current | Num. of poles | Rated Speed | Maximum Speed | F03 (A06) (A106) | F04 (A05) (A105) | F05 (A04) (A104) | F40 | F44 | P01 (A01) (A101) | P02 | P03 (A02) (A102) | P04 (A03) (A103) | P05 (A07) (A107) | P06 (A08) (A108) | P07 (A09) (A109) | P08 (A10) (A110) | P09 (A11) (A111) | P10 (A12) (A112) | P11 (A13) (A113) | P12 (A14) (A114) | P13 (A15) (A115) | P14 (A16) (A116) | P15 (A17) (A117) | P16 (A18) (A118) | P17 (A19) (A119) | P18 (A20) (A120) | P19 (A21) (A121) | P20 (A22) (A122) | P21 (A23) (A123) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GNF2114A | 5.5 | 185 | 20 | 6 | 1500 | 2000 | 2000 | 1500 | 185 | 3 | 150 | 3 | P-OTHER | 5.50 | 20.00 | 6 | 4.02 | 45.57 | 9.76 | 14.96 | 0.001 | 0.001 | 5.45 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 164 |
| GNF2115A | 7.5 | 185 | 29 | 6 | 1500 | 2000 | 2000 | 1500 | 185 | 3 | 150 | 3 | P-OTHER | 7.50 | 29.00 | 6 | 4.76 | 51.21 | 14.30 | 19.94 | 0.001 | 0.001 | 5.33 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 164 |
| GNF2117A | 11 | 185 | 42 | 6 | 1500 | 2000 | 2000 | 1500 | 185 | 3 | 150 | 3 | P-OTHER | 11.00 | 42.00 | 6 | 4.44 | 59.11 | 21.62 | 29.39 | 0.001 | 0.001 | 4.55 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 160 |
| GNF2118A | 15 | 185 | 57 | 6 | 1500 | 2000 | 2000 | 1500 | 185 | 3 | 150 | 3 | P-OTHER | 15.00 | 57.00 | 6 | 4.03 | 45.01 | 26.38 | 41.74 | 0.001 | 0.001 | 4.67 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 157 |
| GNF2136A | 18.5 | 180 | 71 | 6 | 1500 | 2000 | 2000 | 1500 | 180 | 3 | 150 | 3 | P-OTHER | 18.50 | 71.00 | 6 | 2.99 | 51.83 | 38.21 | 47.86 | 0.001 | 0.001 | 4.32 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 161 |
| GNF2137A | 22 | 185 | 82 | 6 | 1500 | 2000 | 2000 | 1500 | 185 | 3 | 150 | 3 | P-OTHER | 22.00 | 82.00 | 6 | 2.93 | 37.62 | 34.95 | 62.56 | 0.001 | 0.001 | 4.09 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 160 |
| GNF2139A | 30 | 180 | 113 | 6 | 1500 | 2000 | 2000 | 1500 | 180 | 3 | 150 | 3 | P-OTHER | 30.00 | 113.0 | 6 | 2.94 | 41.50 | 55.27 | 83.16 | 0.001 | 0.001 | 4.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 157 |
| GNF2165A | 37 | 185 | 140 | 6 | 1500 | 2000 | 2000 | 1500 | 185 | 3 | 150 | 3 | P-OTHER | 37.00 | 140.0 | 6 | 2.76 | 51.88 | 80.41 | 90.78 | 0.001 | 0.001 | 2.97 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 152 |
| GNF2167A | 45 | 185 | 165 | 6 | 1500 | 2000 | 2000 | 1500 | 185 | 3 | 150 | 3 | P-OTHER | 45.00 | 165.0 | 6 | 2.28 | 45.11 | 94.10 | 112.6 | 0.001 | 0.001 | 3.10 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 151 |
| GNF2185A | 55 | 185 | 200 | 6 | 1500 | 2000 | 2000 | 1500 | 185 | 3 | 150 | 3 | P-OTHER | 55.00 | 200.0 | 6 | 2.47 | 47.65 | 122.1 | 126.6 | 0.001 | 0.001 | 3.27 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 162 |
| GNF2187A | 75 | 185 | 270 | 6 | 1500 | 2000 | 2000 | 1500 | 185 | 3 | 150 | 3 | P-OTHER | 75.00 | 270.0 | 6 | 2.12 | 45.27 | 161.8 | 176.4 | 0.001 | 0.001 | 3.20 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 160 |
| GNF2207A | 90 | 185 | 316 | 6 | 1500 | 2000 | 2000 | 1500 | 185 | 3 | 150 | 3 | P-OTHER | 90.00 | 316.0 | 6 | 1.99 | 43.92 | 205.7 | 195.1 | 0.001 | 0.001 | 2.67 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 165 |
| GNF2114A | 5.5 | 370 | 10 | 6 | 1500 | 2000 | 2000 | 1500 | 370 | 3 | 150 | 3 | P-OTHER | 5.50 | 10.00 | 6 | 4.02 | 45.57 | 4.88 | 7.48 | 0.001 | 0.001 | 5.45 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 328 |
| GNF2115A | 7.5 | 370 | 15 | 6 | 1500 | 2000 | 2000 | 1500 | 370 | 3 | 150 | 3 | P-OTHER | 7.50 | 15.00 | 6 | 4.93 | 52.97 | 7.15 | 9.97 | 0.001 | 0.001 | 5.33 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 328 |
| GNF2117A | 11 | 370 | 21 | 6 | 1500 | 2000 | 2000 | 1500 | 370 | 3 | 150 | 3 | P-OTHER | 11.00 | 21.00 | 6 | 4.44 | 59.11 | 10.81 | 14.70 | 0.001 | 0.001 | 4.55 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 320 |
| GNF2118A | 15 | 370 | 29 | 6 | 1500 | 2000 | 2000 | 1500 | 370 | 3 | 150 | 3 | P-OTHER | 15.00 | 29.00 | 6 | 4.10 | 45.80 | 13.09 | 20.90 | 0.001 | 0.001 | 4.67 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 314 |
| GNF2136A | 18.5 | 360 | 36 | 6 | 1500 | 2000 | 2000 | 1500 | 360 | 3 | 150 | 3 | P-OTHER | 18.50 | 36.00 | 6 | 3.03 | 52.56 | 19.11 | 23.93 | 0.001 | 0.001 | 4.32 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 322 |
| GNF2137A | 22 | 370 | 41 | 6 | 1500 | 2000 | 2000 | 1500 | 370 | 3 | 150 | 3 | P-OTHER | 22.00 | 41.00 | 6 | 2.93 | 37.62 | 17.48 | 31.28 | 0.001 | 0.001 | 4.09 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 320 |
| GNF2139A | 30 | 360 | 57 | 6 | 1500 | 2000 | 2000 | 1500 | 360 | 3 | 150 | 3 | P-OTHER | 30.00 | 57.00 | 6 | 2.96 | 41.87 | 27.18 | 41.75 | 0.001 | 0.001 | 4.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 314 |
| GNF2165A | 37 | 370 | 70 | 6 | 1500 | 2000 | 2000 | 1500 | 370 | 3 | 150 | 3 | P-OTHER | 37.00 | 70.0 | 6 | 2.75 | 51.88 | 40.20 | 45.39 | 0.001 | 0.001 | 2.97 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 304 |
| GNF2167A | 45 | 370 | 83 | 6 | 1500 | 2000 | 2000 | 1500 | 370 | 3 | 150 | 3 | P-OTHER | 45.00 | 83.00 | 6 | 2.30 | 45.38 | 47.05 | 56.30 | 0.001 | 0.001 | 3.11 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 302 |
| GNF2185A | 55 | 370 | 100 | 6 | 1500 | 2000 | 2000 | 1500 | 370 | 3 | 150 | 3 | P-OTHER | 55.00 | 100.0 | 6 | 2.47 | 47.65 | 61.33 | 62.46 | 0.001 | 0.001 | 3.27 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 324 |
| GNF2187A | 75 | 370 | 135 | 6 | 1500 | 2000 | 2000 | 1500 | 370 | 3 | 150 | 3 | P-OTHER | 75.00 | 135.0 | 6 | 2.12 | 45.27 | 80.90 | 88.18 | 0.001 | 0.001 | 3.20 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 321 |
| GNF2207A | 90 | 370 | 158 | 6 | 1500 | 2000 | 2000 | 1500 | 370 | 3 | 150 | 3 | P-OTHER | 90.00 | 158.0 | 6 | 1.99 | 43.92 | 102.8 | 97.55 | 0.001 | 0.001 | 2.67 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.001 | 338 |

Table4.3-2　Function code table 2 of Synchronous motor (GNF2)

| Motor Type | Motor Capacity | Rated Voltage | P22 (A24) (A124) | P23 (A25) (A125) | P24 (A26) (A126) | P25 (A27) (A127) | P26 (A28) (A128) | P27 (A29) (A129) | P28 (A30) (A130) | P30 (A31) (A131) | P33 (A53) (A153) | P42 (A62) (A162) | P43 (A63) (A163) | P44 (A64) (A164) | P45 (A65) (A165) | P46 (A66) (A166) | P47 (A67) (A167) | P48 (A68) (A168) | P49 (A69) (A169) | P50 (A70) (A170) | P51 (A71) (A171) | H51 (H52) (H127) | H104 | H160 (H170) (H180) | H161 (H171) (H181) | H162 (H172) (H182) | H163 (H173) (H183) | H164 (H174) (H184) | o09 (A59) (A159) | o11 (A61) (A161) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GNF2114A | 5.5 | 185 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 185 | 95.0 | 100.0 | 50.0 | 0.90 | 0.85 | −0.170 | 0.050 | −3.00 | −3.00 | −0.150 | 0.018 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.258 |
| GNF2115A | 7.5 | 185 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 185 | 95.0 | 100.0 | 72.5 | 1.00 | 0.88 | −0.120 | −0.120 | 0.00 | −3.00 | −0.200 | 0.021 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.204 |
| GNF2117A | 11 | 185 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 185 | 95.0 | 100.0 | 105.0 | 1.00 | 1.15 | −0.100 | −0.250 | −2.00 | −3.00 | −0.170 | 0.027 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.009 |
| GNF2118A | 15 | 185 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 185 | 95.0 | 98.3 | 142.5 | 0.95 | 0.95 | −0.100 | −0.100 | −0.50 | −2.50 | −0.200 | 0.036 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.397 |
| GNF2136A | 18.5 | 180 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 180 | 95.0 | 100.0 | 177.5 | 0.95 | 0.95 | −0.120 | −0.200 | −2.00 | −3.00 | −0.200 | 0.065 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.242 |
| GNF2137A | 22 | 185 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 185 | 95.0 | 100.0 | 205.0 | 0.90 | 0.90 | −0.200 | −0.300 | 0.00 | −3.00 | −0.200 | 0.070 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.548 |
| GNF2139A | 30 | 180 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 180 | 95.0 | 99.9 | 282.5 | 0.90 | 0.90 | −0.150 | −0.150 | −1.00 | −2.00 | −0.200 | 0.090 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.494 |
| GNF2165A | 37 | 185 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 185 | 95.0 | 100.0 | 350.0 | 1.02 | 1.00 | −0.100 | −0.100 | −2.00 | −3.00 | −0.200 | 0.153 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.595 |
| GNF2167A | 45 | 185 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 185 | 95.0 | 98.8 | 412.5 | 0.93 | 0.93 | −0.170 | −0.140 | 0.00 | −2.00 | −0.200 | 0.191 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.770 |
| GNF2185A | 55 | 185 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 185 | 95.0 | 100.0 | 500.0 | 0.95 | 1.00 | −0.100 | −0.100 | −3.00 | −4.00 | −0.200 | 0.350 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.792 |
| GNF2187A | 75 | 185 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 185 | 95.0 | 98.1 | 675.0 | 0.97 | 0.95 | −0.150 | −0.150 | 0.00 | −3.50 | −0.200 | 0.467 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.816 |
| GNF2207A | 90 | 185 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 185 | 95.0 | 100.0 | 790.0 | 1.00 | 1.10 | −0.050 | −0.030 | 0.00 | −3.00 | −0.200 | 0.805 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.929 |
| GNF2114A | 5.5 | 370 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 370 | 95.0 | 100.0 | 25.0 | 0.90 | 0.85 | −0.170 | 0.050 | −3.00 | −3.00 | −0.150 | 0.018 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.258 |
| GNF2115A | 7.5 | 370 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 370 | 95.0 | 100.0 | 36.3 | 1.00 | 0.88 | −0.120 | −0.120 | 0.00 | −3.00 | −0.200 | 0.021 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.204 |
| GNF2117A | 11 | 370 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 370 | 95.0 | 100.0 | 52.5 | 1.00 | 1.15 | −0.100 | −0.250 | −2.00 | −3.00 | −0.170 | 0.027 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.009 |
| GNF2118A | 15 | 370 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 370 | 95.0 | 98.3 | 71.3 | 0.95 | 0.95 | −0.100 | −0.100 | −0.50 | −2.50 | −0.200 | 0.036 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.397 |
| GNF2136A | 18.5 | 360 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 360 | 95.0 | 100.0 | 88.8 | 0.95 | 0.95 | −0.120 | −0.200 | −2.00 | −3.00 | −0.200 | 0.065 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.242 |
| GNF2137A | 22 | 370 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 370 | 95.0 | 100.0 | 102.5 | 0.90 | 0.90 | −0.200 | −0.300 | 0.00 | −3.00 | −0.200 | 0.070 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.548 |
| GNF2139A | 30 | 360 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 360 | 95.0 | 99.9 | 141.3 | 0.90 | 0.90 | −0.150 | −0.150 | −1.00 | −2.00 | −0.200 | 0.090 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.494 |
| GNF2165A | 37 | 370 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 370 | 95.0 | 100.0 | 175.0 | 1.02 | 1.00 | −0.100 | −0.100 | −2.00 | −3.00 | −0.200 | 0.153 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.595 |
| GNF2167A | 45 | 370 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 370 | 95.0 | 98.8 | 206.2 | 0.93 | 0.93 | −0.170 | −0.140 | 0.00 | −2.00 | −0.200 | 0.191 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.776 |
| GNF2185A | 55 | 370 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 370 | 95.0 | 100.0 | 250.0 | 0.95 | 1.00 | −0.100 | −0.100 | −3.00 | −4.00 | −0.200 | 0.350 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.792 |
| GNF2187A | 75 | 370 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 370 | 95.0 | 98.1 | 337.5 | 0.97 | 0.95 | −0.150 | −0.150 | 0.00 | −3.50 | −0.200 | 0.467 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.816 |
| GNF2207A | 90 | 370 | 1.100 | 1.000 | 1.000 | 0.000 | 2.0 | 1.0 | 1024 | 1 | 370 | 95.0 | 100.0 | 395.0 | 1.00 | 1.10 | −0.050 | −0.030 | 0.00 | −3.00 | −0.200 | 0.805 | 1110 | 0 | 80 | 1.0 | 80 | 0 | 1 | 2.929 |

### 4.3.4 V/f control for IM

Under this control, the inverter drives a motor with the voltage and frequency according to the V/f pattern specified by function codes.

■ For Fuji VG motor exclusively designed for vector control

Configure the function codes as listed below. The machinery design values should match your machinery ones.

📖 For details on how to modify the function code data, refer to the FRENIC-VG User's Manual Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET". For details of the function code data, refer to the FRENIC-VG User's Manual Chapter 4, Section 4.3 "Details of Function Codes".

| Function code | Name | Function code data | Factory default |
|---|---|---|---|
| P01<br>A01<br>A101 | M1 Drive Control<br>M2 Drive Control<br>M3 Drive Control | 5: V/f control for IM | 0: Vector control for IM with speed sensor |
| P02 | M1 Selection | Motor to be applied | Motor to be applied |
| P30<br>A31<br>A131 | M1 Thermistor Type<br>M2 Thermistor Type<br>M3 Thermistor Type | 1: NTC thermistor<br>(Specify the thermistor as needed.) | 1: NTC thermistor |
| F04<br>A05<br>A105 | M1 Rated Speed<br>M2 Rated Speed<br>M3 Rated Speed | Motor ratings<br>(printed on the nameplate of the motor) | 1500 r/min |
| F05 | M1 Rated Voltage | | Rated voltage of nominal applied motors |
| A04<br>A104 | M2 Rated Voltage<br>M3 Rated Voltage | | 80 V |
| P33 | M1 Maximum Output Voltage | | 200 V class series: 220 (V)<br>400 V class series: 440 (V) |
| A53<br>A153 | M2 Maximum Output Voltage<br>M3 Maximum Output Voltage | | 80 V |
| F03<br>A06<br>A106 | M1 Maximum Speed<br>M2 Maximum Speed<br>M3 Maximum Speed | Machinery design values<br>**(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly. | 1500 r/min |
| F07 | Acceleration time 1<br>**(Note)** | | 5.00 s |
| F08 | Deceleration time 1<br>**(Note)** | | 5.00 s |
| P35<br>A55<br>A155 | M1 Torque Boost<br>M2 Torque Boost<br>M3 Torque Boost | 2.0 (For constant torque load)<br>**(Note)** In applications requiring a starting torque, adjust the torque boost (P35, A55, A155) within the range from 2.0 to 20.0.) | 0.0 (Auto torque boost) |

■ For motors except Fuji VG motor

Configure the function codes as listed below according to the motor ratings and your machinery design values. The motor ratings are printed on the motor's nameplate. For your machinery design values, ask system designers about them.

In applications requiring a starting torque, adjust the torque boost (P35, A55, A155) within the range from 2.0 to 20.0, or perform motor parameter auto-tuning (H01 = 2) and then set the torque boost (P31, A55, A155) to 0.0 (auto torque boost).

📖 For details on how to modify the function code data, refer to the FRENIC-VG User's Manual Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET". For details of the function code data, refer to the FRENIC-VG User's Manual Chapter 4, Section 4.3 "Details of Function Codes".

| Function code | Name | Function code data | Factory default |
|---|---|---|---|
| P01<br>A01<br>A101 | M1 Drive Control<br>M2 Drive Control<br>M3 Drive Control | 5: V/f control for IM | 0: Vector control for IM |
| P02 | M1 Selection | 37: Others<br>(No modification is required for M2 or M3.) | Motor to be applied |
| P30<br>A31<br>A131 | M1 Thermistor Type<br>M2 Thermistor Type<br>M3 Thermistor Type | 0: No thermistor | 1: NTC thermistor |
| F04<br>A05<br>A105 | M1 Rated Speed<br>M2 Rated Speed<br>M3 Rated Speed | Motor ratings<br>(printed on the nameplate of the motor) | 1500 r/min |
| F05 | M1 Rated Voltage | | Rated voltage of nominal applied motors |
| A04<br>A104 | M2 Rated Voltage<br>M3 Rated Voltage | | 80 V |
| P33 | M1 Maximum Output Voltage | | 200 V class series: 220 (V)<br>400 V class series: 440 (V) |
| A53<br>A153 | M2 Maximum Output Voltage<br>M3 Maximum Output Voltage | | 80 V |
| P03 | M1 Rated Capacity | | Capacity of nominal applied motors |
| A02<br>A102 | M2 Rated Capacity<br>M3 Rated Capacity | | 0.00 kW |
| P04 | M1 Rated Current | | Rated current of nominal applied motors |
| A03<br>A103 | M2 Rated Current<br>M3 Rated Current | | 0.01 A |
| P05<br>A07<br>A107 | M1 Poles<br>M2 Poles<br>M3 Poles | | 4 poles |
| F03<br>A06<br>A106 | M1 Maximum Speed<br>M2 Maximum Speed<br>M3 Maximum Speed | Machinery design values<br>**(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly. | 1500 r/min |
| F07 | Acceleration time 1<br>**(Note)** | | 5.00 s |
| F08 | Deceleration time 1<br>**(Note)** | | 5.00 s |
| P35<br>A55<br>A155 | M1 Torque Boost<br>M2 Torque Boost<br>M3 Torque Boost | 2.0 (For constant torque load) | 0.0 (Auto torque boost) |
| P06 | M1 %R1 | To use the auto torque boost function (P35, A55, A155 = 0.0), be sure to perform motor parameter auto-tuning (H01 =2). | Depends on the rated capacity. |
| A08<br>A108 | M2 %R1<br>M3 %R1 | | 0.00% |
| P07 | M1 %X | | Depends on the rated capacity. |
| A09<br>A109 | M2 %X<br>M3 %X | | 0.00% |

For the motor parameter auto-tuning procedure (H01 = 2), refer to the FRENIC-VG User's Manual Chapter 4, Section 4.3.5 "H Codes (High performance Functions)."

| Function code | Name | Function code data | Factory default |
|---|---|---|---|
| H01 | Tuning Selection | 2: Auto-tuning (R1, Lσ) | 0: Disable |

Note Performing motor parameter auto-tuning (H01 = 2) automatically changes the data of function codes P06 and P07 for M1, A08 and A09 for M2, and A108 and A109 for M3. Be careful with this data change.

After tuning, be sure to perform the full save function (H02 = 1) to save the tuned data into the inverter.

## 4.4 Running the Inverter for Operation Check

**⚠WARNING**

- If the user configures the function codes without completely understanding this Instruction Manual and the FRENIC-VG User's Manual, the motor may rotate with a torque or at a speed not permitted for the machine.
- When making a test run with a permanent magnet synchronous motor (PMSM), be sure to observe the test run procedure given in Section 4.4.2. If wiring between the inverter and motor or PG wiring is wrong, or the magnetic pole position offset is improper, the motor may run out of control.

**An accident or injuries may result.**

After completion of preparations for a test run as described above, start running the inverter for motor operation check using the following procedure.

**⚠CAUTION**

If any abnormality is found in the inverter or motor, immediately stop operation and investigate the cause referring to Chapter 6, "TROUBLESHOOTING."

### 4.4.1 Test Run Procedure for Induction Motor (IM)

(1) Turn the power ON and check that the reference speed is 0 r/min and it is blinking on the LED monitor.

(2) Set a low reference speed such as 100 r/min, using ⌃ / ⌄ keys. (Check that the speed is blinking on the LED monitor.)

(3) To run the motor in the forward direction, press the FWD key; to run it in the reverse direction, press the REV key. (Check that the speed is lit on the LED monitor.)

(4) Press the STOP key to stop the motor.

**< Check points during a test run >**

- Check that the motor is running in the forward direction when it is driven with the FWD key.
- Check that the motor is running in the reverse direction when it is driven with the REV key.
- Check for smooth rotation without motor humming or excessive vibration.
- Check for smooth acceleration and deceleration.

When no abnormality is found, press the FWD or REV key again to start driving the motor, then increase the reference speed using ⌃ / ⌄ keys. Check the above points again.

### 4.4.2 Test Run Procedure for Permanent Magnet Synchronous Motor (PMSM)

#### [ 1 ] Before proceeding with a test run

This section provides a test run procedure for the configuration consisting of the FRENIC-VG, the interface card for PMPG drive (OPC-VG1-PMPG), and a PMSM using a UVW phase detection PG (including GNF2 motor).

For a test run using a PMSM, it is recommended that the motor be disconnected from the equipment for testing it by itself. If it is impossible to drive the motor by itself due to the equipment, however, make a test run under the conditions that cause no problems even if the motor runs continuously in one direction (forward or reverse).

#### [ 2 ] Preparation for a test run

(1) Before turning the inverter power ON, make checking given in Section 4.1 "Checking Prior to Powering On."

(2) Check that wiring of the encoder (PG) is correct.
(For the connection diagram, refer to the User's Manual, Chapter 2, Section 2.7.1.2 "In combination with a dedicated PMSM (GNF2 type).")

| ⚠CAUTION |
|---|
| Wrong wiring may break the PG.<br>If the inverter is powered on with wrong wiring, disconnect the PG signal wires from the inverter, keep only the PG powered on via the PGP and PGM, and then check that each signal is correctly output with an oscilloscope or recorder. |

(3) Turn the power ON, make a note of the current configuration of all function codes, and then change the function code data as listed in Table 4.4-1.

(4) Check that the magnetic pole position offset (o10) is set to the previously specified value or manually adjusted value.
Replacing the motor or encoder requires adjustment of the magnetic pole position offset again.

Table 4.4-1 Configuration for Test Run of PMSM

| Function code | Name | Current configuration before test run (Values given below are factory defaults) | | Configuration for test run | |
|---|---|---|---|---|---|
| F01 | Speed Command N1 | 0 | The current configuration of function codes differs depending upon the equipment specifications.<br>Make a note of the current configuration and then change the function code data as shown at the right. | 0 | 0: Enable the ⌃ and ⌄ keys on the keypad (Digital speed setting) |
| F02 | Operation Method | 0 | | 0 | 0: Enable the FWD, REV and STOP keys on the keypad to run or stop the motor. |
| F03 | Maximum Speed M1 | 1500 r/min | | 750 r/min | Set about half of the current value (before test run). |
| F40 | Torque Limiter Mode 1 | 0 (Disable) | | 3 | 3: Torque current limit |
| F44 | Torque Limiter Level 1 | 150% | | 10% | If motor power wires or encoder wires are wrongly connected, the motor may run out of control, breaking the equipment. To suppress abrupt acceleration at the time of runaway, decrease the torque limiter level. |
| E45 | Speed Disagreement Alarm | 00 (Disable) | | 01 | Speed disagreement alarm: Enable<br>Power supply phase loss detection: Disable |

**Note 1:** If the moment of inertia of the coupled equipment is large, the motor may not run at a test run. If it happens, adjust the torque limiter level 1 properly.

**Note 2:** After a test run, revert the function code data to the previous values.

### [ 3 ] Setting the magnetic pole position sensor offset value

| ⚠CAUTION |
|---|
| Be sure to adjust the magnetic pole position offset (see below for the adjustment procedure):<br>- when the inverter runs for the first time after purchase<br>- after replacement of a motor, PG or inverter<br>Running the inverter with the magnetic pole position offset (o10, A60, A160) not adjusted or with the position deviated greatly from the true value could run the motor in the opposite direction or out of control in the worst case.<br>**An accident or injuries could occur.** |

When driving a PMSM for the first time, be sure to set the magnetic pole position sensor offset value to the inverter with the following function code(s) beforehand.

M1: Function code o10
M2: Function code A60
M3: Function code A160

Depending on the situation, Choose from the following three ways to set.

**(1) Case where the magnetic pole position offset value is indicated on the label that came with the motor.**

The magnetic pole position sensor offset value, which differs according to motors, is printed on the magnetic pole position label attached to the motor main circuit line (U phase). (See Figure 4.4-1)

As shown in Figure 4.4-2, there are two types of magnetic pole position labels.

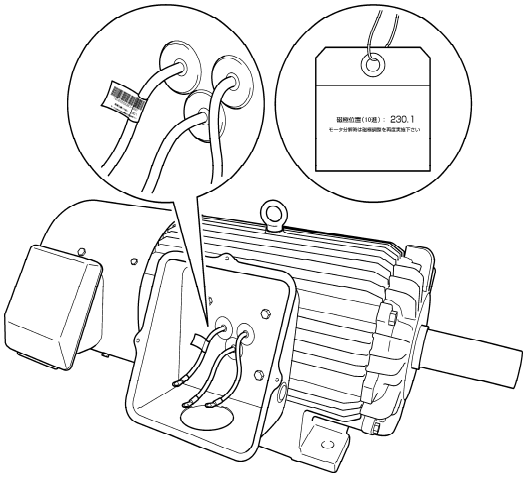


Figure 4.4-1 Magnetic Pole Position Offset Label Attaching Position Examples

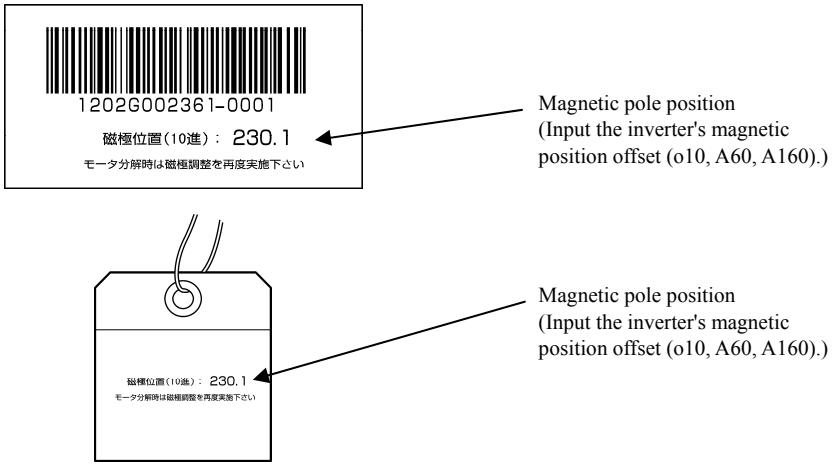



Figure 4.4-2 Magnetic Pole Position Offset Labels

Note Replacing the motor or encoder requires adjustment of the magnetic pole position offset again.

**(2) Case where the automatically adjust magnetic pole position offset value**

If there is no display label offset pole position, or When PG is mounted or replaced at the site, the magnetic pole position offset value is adjusted automatically by tuning function (H71=5).

Tuning is successful, the data is automatically saved to "o10" (magnetic pole position offset).

< Conditions that magnetic pole position offset tuning are available >

1) The equipment that do not become dangerous even if the motor rotate.

2) There is no load change of the equipment, motor rotation is stable.

If the above condition is not satisfied, it is necessary to remove the motor from the equipment.

3) PG (encoder) is only supported in ABUVW encoder.

< Tuning procedure >

1) Before the start of tuning, set the following function code.

· P01=“3” ( Vector control (SM))

· o09=”1” ( ABUVW encoder )

· F02=“0” (KEYPAD operation )

2) Start tuning. Set H71 = "5" (Magnet pole position tuning (for SM driving)).

Change the H71 data to the desired value by pressing the STOP + ⌃ keys or STOP + ⌄ keys (simultaneous keying), and then press the FUNC DATA key

3) Press the FWD key to start tuning.

4) Upon completion of auto-tuning, the H71 data automatically reverts to "0."

5) Tuning result is stored in o10.

📖 When choosing the motor 2 (M2) or the motor 3 (M3), perform the tuning substitute the function code as shown in the below table.

| Motor 1 (M1) | Motor 2 (M2) | Motor 3 (M3) |
|---|---|---|
| P01 | A01 | A101 |
| o09 | A59 | A159 |
| o10 | A60 | A160 |

< Function code for adjusting >

The following function code, function code is used to adjust when tuning. Normally, please leave the factory default settings.

· H161 (M1 Draw current command)

· H171 (M2 Draw current command)

· H181 (M3 Draw current command)

Data setting range : 10 to 200(%)  Default setting : 80(%)

(Definition of 100% is "P04" set value (M1 rated current).)

*) If the motor does not move from a stopped state or the motor vibrates, might be able to resolve by increasing the current to be set.

· H162 (M1 Draw frequency)

· H172 (M2 Draw frequency)

· H182 (M3 Draw frequency)

Data setting range : 0.1~10.0(Hz)  Default setting : 1.0(Hz)

*) If the motor vibrates, might be able to resolve by lowering the frequency to be set.

📖 For details on how to modify the function code data, refer to the FRENIC-VG User's Manual Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET". For details of the function code data, refer to the FRENIC-VG User's Manual Chapter 4, Section 4.3 "Details of Function Codes".

< Tuning notes >

If tuning can not start normally, check and wiring by referring to the following setting.

1) "NOT EXECUTE" appears on the LCD monitor.

In the case of M1, when H01 = any of 2 to 4, P02 ≠ 37 (OTHER).

⇒ Function codes to be tuned are write-protected. Set P02 to "37" (OTHER).

The JOG mode is selected. (The JOG indicator on the LCD monitor is lit.)

⇒ Cancel the JOG mode by pressing the STOP + ∧ keys (simultaneous keying).

⇒ If digital input signal ***JOG*** is ON, turn it OFF.

2) Alarm Er-5 (Operation error) occurs.

Have the setting P01≠ 3, o09 ≠ 1, H160 ≠ 0.

⇒ Set P01= 3, o09 = 1, H160= 0.

Any of digital input signals ***BX***, ***STOP1***, ***STOP2*** and ***STOP3*** is ON.

Either one of Enable inputs [EN1] and [EN2] is OFF.

⇒ When any of ***BX***, ***STOP1***, ***STOP2*** and ***STOP3*** is ON and either of [EN1] and [EN2] is OFF, no tuning starts.

The multiwinding motor drive system is selected.

⇒ No tuning is possible in the multiwinding motor drive system.

3) Alarm Er-7 (Output wiring fault) occurs.

A phase is missing in the connection between the inverter and the motor.

⇒ Connect the motor to the inverter correctly.

The brake is applied to the motor.

⇒ For auto-tuning with the motor running (H01 = 4), be sure to release the brake so that the motor can rotate.

The motor does not rotate. The motor is vibrating.

⇒ Motor 1 (M1) : Need to be adjusted H161 (M1 Draw current command), H162 (M1 Draw frequency).

⇒ Motor 1 (M2) : Need to be adjusted H171 (M2 Draw current command), H172 (M2 Draw frequency).

⇒ Motor 1 (M3) : Need to be adjusted H181 (M3 Draw current command), H182 (M3 Draw frequency).

4) Alarm PG (PG wire break) occurs.

it is possible that the connection of the PG is incorrect.

⇒ Check the wiring of the PG.

## ⚠WARNING

- The motor rotates when you start the auto-tuning. Check that it is not dangerous enough even when the motor is rotating.
  **An accident or injuries could occur.**

**(3) Case where the manually adjust magnetic pole position offset value**

If unable to tune the magnetic pole position offset can be adjusted manually according to the following method is possible. In addition, the method of this adjustment, check the current magnetic pole position offset value is possible.

Configure the following parameters beforehand.

- E69 (Terminal [Ao1] Function) : 26 (U phase voltage)
- E70 (Terminal [Ao2] Function) : 39 (Magnetic pole position signal ***SMP*)**
- E84 (Ao1-5 Filter Setting) : 0.000 s (Cancel filter)

Rotate the motor shaft by hand to check that the positional relationship between the waveforms on Ao1 and Ao2 is as shown below. If the waveforms are greatly misaligned, adjust the data of function code o10 to align the waveforms as shown below.

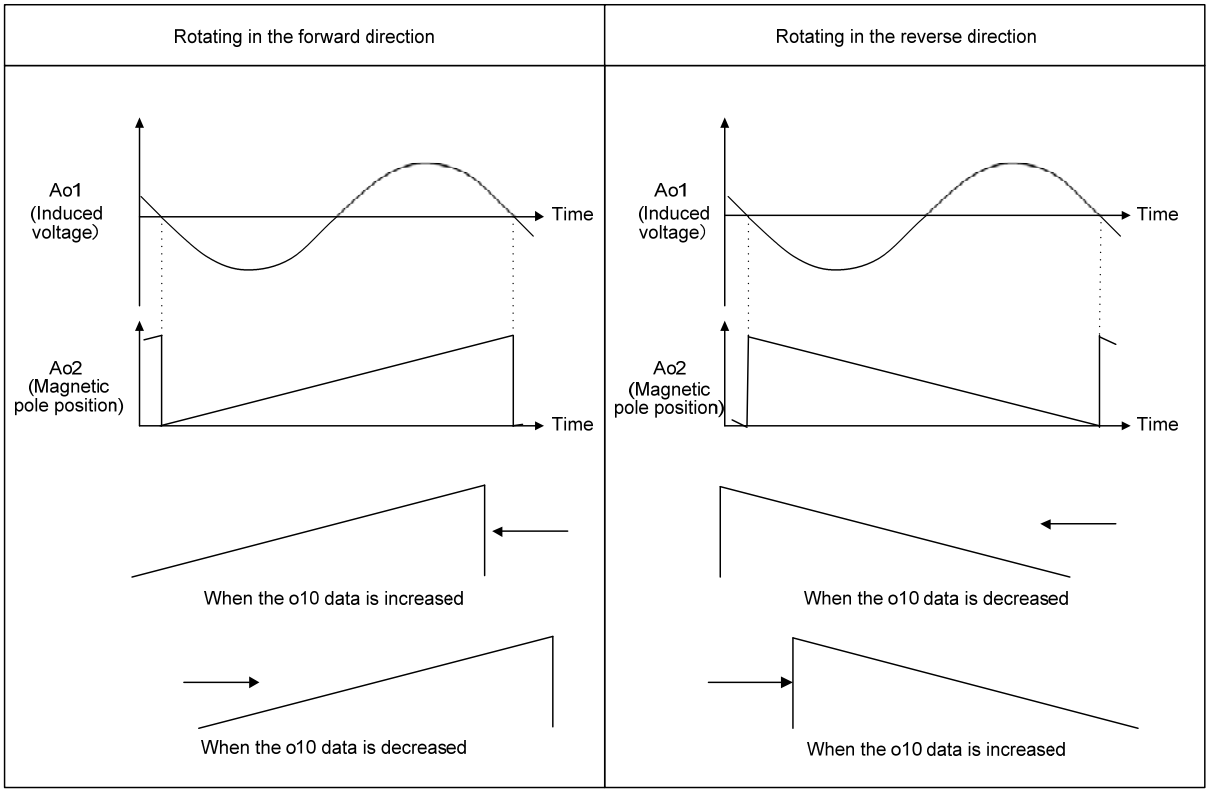



Figure 4.4-3 Adjustment of Magnetic Pole Position

Note If the PG alarm occurs during adjustment, it is possible that the connection of the PG is incorrect. Check the wiring of the PG.

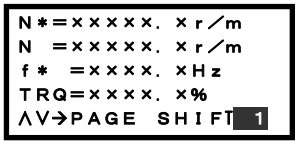
### [ 3 ] Test run

(1) Turn the power ON and check that the reference speed is 0 r/min and it is blinking on the LED monitor.

(2) Set a low reference speed such as 100 r/min, using ∧ / ∨ keys. (Check that the speed is blinking on the LED monitor.)

(3) Set the maximum speed (F03) to *750* r/min.

(4) Shift the LCD monitor to Menu #3 "OPR MNTR" to show the speed (N∗, N).




(5) To run the motor in the forward direction, press the FWD key; to run it in the reverse direction, press the REV key.

Check that:

- The speed on the LED monitor comes ON instead of blinking
- The motor accelerates up to the specified speed.
- There is no abnormal discrepancy between the reference speed (*N) and the detected speed (N) shown on the LCD monitor.

(6) Press the STOP key to stop the motor.

(7) If no alarm occurs or no problem is found in motor running, increase the speed with the ∧ / ∨ keys.

(8) Turn the run command OFF.

**< Check points during a test run >**

- Check that the motor is running in the forward direction when it is driven with the FWD key.
- Check that the motor is running in the reverse direction when it is driven with the REV key.
- Check for smooth rotation without motor humming or excessive vibration.
- Check for smooth acceleration and deceleration.

When no abnormality is found, press the FWD or REV key again to start driving the motor, then increase the reference speed using ∧ / ∨ keys. Check the above points during a test run.

### [ 4 ] Troubleshooting for motor abnormality

If any of the following abnormalities is found during a test run, follow the troubleshooting procedure in Table 4.4-2.

- Turning the inverter ON triggers a PG alarm.
- Entering a run command triggers a PG or Er-9 alarm.
- Entering a run command does not run the motor or increase the speed.

Table 4.4-2 Troubleshooting for Motor Abnormality

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) Setting of torque limiter level 1 too small relative to the load. | Check the setting of the torque limiter level 1 (F44).<br>➔ Increase the F44 data in increments of 5%. |
| (2) Wrong wiring between the inverter and motor. | Check the wiring between the inverter and motor.<br>➔ Correct the wiring. |
| (3) Wrong PG wiring. | Check the wiring of the PG.<br>➔ Correct the wiring. |
| (4) PMSM magnetic pole position not matched. | Check the magnetic pole position.<br>➔ Adjust the magnetic pole position (o10, A60, A160), referring to "■ Setting the magnetic pole position sensor offset value","■ Adjusting the magnetic pole position" in Section 4.3.3. |

## 4.5 Selecting a Speed Command Source

A speed command source is the keypad (⌃ / ⌄ keys) by factory default. This section provides the speed command setting procedures using the speed command sources of the keypad, external potentiometer, and speed selection terminal commands.

### 4.5.1 Setting up a speed command from the keypad

Follow the procedure given below.

(1) Configure the function codes as listed below.

| Function code | Name | Function code data | Factory default |
|---|---|---|---|
| F01 | Speed Command Source N1 | 0: Keypad (⌃ / ⌄ keys) | 0 |

Note
- When the inverter is in Programming or Alarm mode, speed command setting with ⌃ / ⌄ keys is disabled. To enable it, switch to Running mode.
- If any of higher priority speed command sources (multistep speed commands and speed commands via communications link) is specified, the inverter may run at an unexpected speed.

(2) Press the ⌃ / ⌄ key to display the current speed command on the LED monitor. The least significant digit blinks.

(3) To change the speed command, press the ⌃ / ⌄ key again.
When you start specifying the speed command with the ⌃ / ⌄ key, the least significant digit on the display blinks; that it, the cursor lies in the least significant digit. Holding down the ⌃ / ⌄ key changes data in the least significant digit and generates a carry, while the cursor remains in the least significant digit.

(4) To save the new setting into the inverter's memory, press the FUNC/DATA key.

📖 For details on how to modify the function code data, refer to the FRENIC-VG User's Manual Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET".

### 4.5.2 Setting up a speed command with an external potentiometer

Follow the procedure given below.

(1) Configure the function codes as listed below.

| Function code | Name | Function code data | Factory default |
|---|---|---|---|
| F01 | Speed Command Source N1 | 1: Analog voltage input to terminal [12] (0 to ±10 V) | 0 |

(2) Connect an external potentiometer to terminals [11] through [13] of the inverter.

(3) Rotate the external potentiometer to apply voltage to terminal [12] for a speed command input.

📖 For precautions in wiring, refer to Chapter 2 "MOUNTING AND WIRING THE INVERTER."

📖 For details on how to modify the function code data, refer to the FRENIC-VG User's Manual Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET".

## 4.6 Selecting a Run Command Source

A run command source is the keypad (FWD / REV / STOP keys) by factory default.

### 4.6.1 Setting up a run command from the keypad

Follow the procedure given below.

(1) Configure the function codes as listed below.

| Function code | Name | Function code data | Factory default |
|---|---|---|---|
| F02 | Operation Method | 0: Keypad (FWD / REV / STOP keys) | 0: Keypad (FWD / REV / STOP keys) |

(2) Press the FWD key to run the motor in the forward direction. Press the STOP key to stop it.

(3) Press the REV key to run the motor in the reverse direction. Press the STOP key to stop it.

📖 For details on how to modify the function code data, refer to the FRENIC-VG User's Manual Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET".

### 4.6.2 Setting up a run command with digital input signals (terminals [FWD] and [REV])

Follow the procedure given below.

(1) Configure the function codes as listed below.

| Function code | Name | Function code data | Factory default |
|---|---|---|---|
| F02 | Operation Method | 1: External digital input signal | 0: Keypad (FWD / REV / STOP keys) |

Note If terminal [FWD] and [REV] are ON, the F02 data cannot be changed. First turn those terminals OFF and then change the F02 data.

(2) Connect the run forward switch between terminals [FWD] and [CM] and the run reverse switch between [REV] and [CM].

Note Make sure that the SINK/SOURCE slide switch (SW1) is turned to the SINK position. If SW1 is in the SOURCE position, the inverter cannot run the motor.

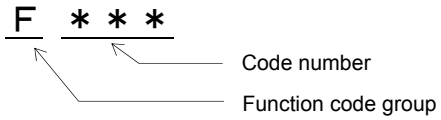
(3) Turn the run forward switch or run reverse switch ON (short-circuit) to run the motor in the forward or reverse direction, respectively.

📖 For precautions in wiring, refer to Chapter 2 "MOUNTING AND WIRING THE INVERTER."

📖 For details on how to modify the function code data, refer to the FRENIC-VG User's Manual Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET".

# Chapter 5 FUNCTION CODES

## 5.1 Function Code Groups and Function Codes




| Function code group | | Function codes | Remarks | |
|---|---|---|---|---|
| **F**undamental functions | **F** codes | F00 to F85 | | |
| **E**xtension terminal functions | **E** codes | E01 to E118 | | |
| | | | E51, E52 | For the OPC-VG1-AIO option |
| | | | E55, E56 | |
| | | | E59, E60 | |
| | | | E63, E64 | |
| | | | E67, E68 | |
| | | | E72, E73 | |
| | | | E77, E78 | |
| | | | E82, E83 | |
| | | | E103, E104 | |
| | | | E107, E108 | |
| **C**ontrol functions | **C** codes | C01 to C73 | | |
| Motor **P**arameter functions M1 | **P** codes | P01 to P51 | For M1. | |
| **H**igh performance function | **H** codes | H01 to H228 | | |
| **A**lternative motor parameter functions M2/M3 | **A** codes | A01 to A171 | For M2 and M3. | |
| **o**ption functions | **o** codes | o05 to o197 | o01 to o04 | For the OPC-VG1-DIA, DIB option. |
| | | | o05 | For the OPC-VG1-PG (PD) option. |
| | | | o06 to o08 | For the OPC-VG1-PG (LD) option. |
| | | | o09 to o11 | For the OPC-VG1-PMPG option. |
| | | | o12 to o19 | For the OPC-VG1-PG (PR) option. |
| | | | o29 to o32 | For communications options (e.g., OPC-VG1-TL, OPC-VG1-CCL). |
| | | | o33, o34, o50 | For the high-speed serial communication terminal block OPC-VG1-TBSI. |
| | | | o35 to o36 | For the OPC-VG1-SIU option (available soon). |
| | | | o122 to o197 | For communications options. |
| **L**ift functions | **L** codes | L01 to L15 | | |
| **U**ser functions | **U** codes | U01 to U64 | For the UPAC option. | |
| | | U101 to U150 | For manufacturers. | |
| **S**a**F**ety functions | **SF** codes | SF00 to SF31 | For functional safety. For details, refer to the Functional Safety card Instruction Manual. | |
| **S**erial communication functions | **S** codes | S01 to S17 | Commands | Accessible in local mode (keypad), via the communications link (T-Link, RS-485, SIU, SX-bus, and fieldbus), and via the UPAC. |
| **M**onitoring functions | **M** codes | M01 to M222 | Data monitor | |

📖 Function codes Tables are stated only "F ~ H" code. For details of the other function code data, refer to the FRENIC-VG User's Manual Chapter 4, Section 4.2 "Function Codes Tables".

📖 For details of the function code data, refer to the FRENIC-VG User's Manual Chapter 4, Section 4.3 "Details of Function Codes".

## 5.2 About the Contents of Column Headers in Function Code Tables

| Column Headers | | Description |
|---|---|---|
| Function code | | Function code group and code number |
| Communications address | 485 No. | Address to be used to refer to or change function code data using a communications option.<br>Available for all communications options except OPC-VG1-TL. |
| | Link No. | Address to be used to refer to or change function code data using a communications option (OPC-VG1-TL, OPC-VG1-SX, etc.).<br>Blank link number fields mean that the corresponding function codes cannot be accessed via a field option. |
| Name | | Name assigned to a function code. |
| Dir. | | Number of subdirectories in the keypad directory structure.<br>0: Parent directory having no subdirectories<br>1: Subdirectory<br>2 or more: Parent directory having the specified number of subdirectories |
| Data setting range | | Allowable data setting range and definition of each data. |
| Change when running | | Indicates whether the function code data can be changed or not when the inverter is running.<br>Y: Possible, N: Impossible |
| Default setting | | Data preset by factory default.<br>If data is changed from the factory default, it is displayed with an asterisk (*) on the keypad.<br>Using function code H03 reverts changed function code data to the default values. |
| Data copying | | Indicates whether or not the function code data can be copied when you copy the data stored in the keypad memory of a source inverter to other destination inverters. |
| Initialization | | Indicates whether or not the function code data can be initialized to the default value by function code H03 (Data initialization).<br>Y: Possible, N: Impossible |
| Format type | | Indicates a format type to be used to refer to or change function code data via the communications link. |
| Drive control (Availability) | | Indicates whether or not the function code is available to the individual drive controls.<br>Y: Available, N: Not available<br>Drive controls:<br>VC w/ PG: Vector control for induction motor (IM) with speed sensor<br>VC w/o PG: Vector control for induction motor (IM) without speed sensor<br>V/f: V/f control for induction motor (IM)<br>VC for PMSM: Vector control for permanent magnet synchronous motor (PMSM) with speed sensor |

📖 For details about the format type, refer to the FRENIC-VG User's Manual, Chapter 4, Section 4.2.4 "Data format list."

## 5.3 Function Code Tables

### 5.3.1 F codes (Fundamental Functions)

| Function code | Communications address 485 No. | Communications address Link No. | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control: VC w/ PG | Drive control: VC w/o PG | Drive control: V/f | Drive control: VC for PMSM | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F00 | 0h | 50h | Data Protection | 0 | 0 or 1<br>0: Enable data change<br>1: Protect data<br>This write-protects data from the keypad.<br>H29 defines write-protect from the communications link (T-link, RS-485, etc.) | N | 0 | N | Y | 40 | Y | Y | Y | Y | |
| F01 | 1h | h | Speed Command N1 | 0 | 0 to 9<br>0: Keypad (▲/▼ keys)<br>1: Analog input to terminal [12](0 to ±10V)<br>2: Analog input to terminal [12](0 to +10V)<br>3: ***UP/DOWN*** control (Initial speed = 0)<br>4: ***UP/DOWN*** control (Initial speed = Last value)<br>5: ***UP/DOWN*** control (Initial speed = Creep speed 1 or 2)<br>6: DIA card input<br>7: DIB card input<br>8: ***N-REFV*** input to terminal [Ai1]<br>9: ***N-REFC*** input to terminal [Ai2]<br>F01 defines the command source that specifies a speed command. | N | 0 | Y | Y | 41 | Y | Y | Y | Y | |
| F02 | 2h | h | Operation Method | 0 | 0 or 1<br>0: Keypad (FWD/REV/STOP keys) (Local mode)<br>1: External signals to terminals ***FWD***/***REV*** (Remote mode)<br>F02 defines a run command source.<br>Switching between the Remote and Local modes is also possible with the simultaneous depression of the RESET + STOP keys on the keypad, which changes the F02 data. | N | 0 | Y | Y | 42 | Y | Y | Y | Y | |
| F03 | 3h | 51h | Maximum Speed M1 | 3 | 50 to 30000 r/min | N | 1500 | Y | N | 0 | Y | Y | Y | Y | |
| F04 | 4h | 52h | Rated Speed M1 | 1 | 50 to 30000 r/min | N | * | Y | N | 0 | Y | Y | Y | Y | |
| F05 | 5h | 53h | Rated Voltage M1 | 1 | 80 to 999 V | N | * | Y | N | 0 | Y | Y | Y | Y | |
| F07 | 7h | 54h | Acceleration Time 1 | 0 | 0.01 to 99.99 s<br>100.0 to 999.9 s<br>1000 to 3600 s | Y | 5.00 | Y | Y | 13 | Y | Y | Y | Y | |
| F08 | 8h | 55h | Deceleration Time 1 | 0 | 0.01 to 99.99 s<br>100.0 to 999.9 s<br>1000 to 3600 s | Y | 5.00 | Y | Y | 13 | Y | Y | Y | Y | |
| F10 | Ah | 56h | M1 Electronic Thermal Overload Protection (Select motor characteristics) | 3 | 0 to 2<br>0: Disable (For a VG-dedicated motor)<br>1: Enable (For a general-purpose motor with shaft-driven cooling fan)<br>2: Enable (For an inverter-driven motor with separately powered cooling fan) | Y | 0 | Y | N | 85 | Y | Y | Y | Y | |
| F11 | Bh | 57h | (Detection level) | 1 | 0.01 to 99.99 A<br>100.0 to 999.9 A<br>1000 to 2000 A | Y | * | Y | N | 13 | Y | Y | Y | Y | |
| F12 | Ch | 58h | (Thermal time constant) | 1 | 0.5 to 75.0 min | Y | * | Y | N | 2 | Y | Y | Y | Y | |
| F14 | Eh | h | Restart Mode after Momentary Power Failure (Mode selection) | 0 | 0 to 5<br>0: No restart (Trip immediately, with alarm ⟨⟨⟨⟨)<br>1: No restart (Trip after recovery from power failure, with alarm ⟨⟨⟨⟨)<br>2: No restart (Trip after decelerate-to-stop, with alarm ⟨⟨⟨⟨)<br>3: Restart (Continue to run)<br>4: Restart at the speed at which the power failure occurred<br>5: Restart at the starting speed | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| F17 | 11h | h | Gain (for terminal [12] input) | 0 | 0.0 to 200.0%<br>Ratio to analog speed setting on terminal [12].<br>Limited to ±110% of the maximum speed. | Y | 100.0 | Y | Y | 2 | Y | Y | Y | Y | |
| F18 | 12h | h | Bias (for terminal [12] input) | 0 | -30000 to 30000 r/min<br>Bias to analog speed setting on terminal [12].<br>Limited to ±110% of the maximum speed | Y | 0 | Y | Y | 5 | Y | Y | Y | Y | |
| F20 | 14h | 59h | DC Braking (Braking starting speed) | 3 | 0 to 3600 r/min | Y | 0 | Y | Y | 0 | Y | Y | Y | N | |
| F21 | 15h | 5Ah | (Braking level) | 1 | 0 to 100% | Y | 0 | Y | Y | 16 | Y | Y | Y | N | |
| F22 | 16h | 5Bh | (Braking time) | 1 | 0.0 to 30.0 s<br>0.0: Disable<br>0.1 to 30.0 s | Y | 0.0 | Y | Y | 2 | Y | Y | Y | N | |

*Depending upon the inverter's capacity.

| Function code | Communications address | | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 485 No. | Link No. | | | | | | | | | VC w/ PG | VC w/o PG | V/f | VC for PMSM | |
| F23 | 17h | 5Ch | Starting Speed (Speed) | 0 | 0.0 to 150.0 r/min<br>Limited in order not to lower to 0.1 Hz or below (under vector control w/o speed sensor and V/f control).<br>Use F23 for assuring the torque at startup. | N | 0.0 | Y | Y | 2 | Y | Y | Y | Y | |
| F24 | 18h | 5Dh | (Holding time) | 0 | 0.00 to 10.00 s | N | 0.00 | Y | Y | 3 | Y | Y | Y | Y | |
| F26 | 1Ah | 5Eh | Motor Sound (Carrier frequency) | 0 | 2 to 15 kHz<br>2: 2 kHz<br>3: 3 kHz<br>4: 4 kHz<br>5: 5 kHz<br>6: 6 kHz<br>7: 7 kHz<br>8, 9: 8 kHz<br>10, 11: 10 kHz<br>12, 13, 14: 12 kHz<br>15: 15 kHz<br>This controls the carrier frequency to reduce an audible noise generated by the motor or electromagnetic noise from the inverter itself, to suppress the resonance with the machinery, and to decrease a leakage current from the output circuit wirings. | N | 8 for 55 kW or below<br>7 for 75 kW or above | Y | Y | 10 | Y | Y | Y | Y | |
| F36 | 24h | h | 30RY Drive Mode | 0 | 0 or 1<br>0: Excite relay (30) when an alarm occurs<br>1: Excite relay (30) when the inverter power is normally established | N | 0 | Y | Y | 43 | Y | Y | Y | Y | |
| F37 | 25h | 60h | Stop Speed (Speed) | 3 | 0.0 to 150.0 r/min<br>Limited in order not to lower to 0.1 Hz or below (under vector control w/o speed sensor and V/f control). | N | 10.0 | Y | Y | 2 | Y | Y | Y | Y | |
| F38 | 26h | 61h | (Detection mode) | 1 | 0 or 1<br>0: Detected speed<br>1: Reference speed<br>Fixed at "1" under V/f control | N | 0 | Y | Y | 90 | Y | N | N | Y | |
| F39 | 27h | 62h | (Zero speed control holding time) | 1 | 0.00 to 10.00 s<br>Applies to when timing the application of the mechanical brake. | N | 0.50 | Y | Y | 3 | Y | N | N | Y | |
| F40 | 28h | 63h | Torque Limiter Mode 1 | 12 | 0 to 3<br>0: Disable limiter<br>1: Torque limit<br>2: Power limit<br>3: Torque current limit | N | 0 | Y | Y | 44 | Y | Y | N | Y | |
| F41 | 29h | 64h | Torque Limiter Mode 2 | 1 | 0 to 3<br>0: Level 1 to all four quadrants<br>1: Level 1 to driving, Level 2 to braking<br>2: Level 1 to upper limit, Level 2 to lower limit<br>3: Level 1/Level 2 (switchable) to all four quadrants<br>Levels 1 and 2 are specified by the source defined by F42 and F43, respectively. | N | 0 | Y | Y | 45 | Y | Y | Y | Y | |
| F42 | 2Ah | 65h | Torque Limiter Level 1 Source | 1 | 0 to 5<br>0: Function code F44<br>1: Ai [TL-REF1]<br>2: DIA card<br>3: DIB card<br>4: Communications link<br>5: PID output | N | 0 | Y | Y | 46 | Y | Y | Y | Y | |
| F43 | 2Bh | 66h | Torque Limiter Level 2 Source | 1 | 0 to 5<br>0: Function code F45<br>1: Ai [TL-REF2]<br>2: DIA card<br>3: DIB card<br>4: Communications link<br>5: PID output | N | 0 | Y | Y | 47 | Y | Y | Y | Y | |
| F44 | 2Ch | 67h | Torque Limiter Level 1 | 1 | -300 to 300% | Y | 150 | Y | Y | 5 | Y | Y | Y | Y | |
| F45 | 2Dh | 68h | Torque Limiter Level 2 | 1 | -300 to 300% | Y | 10 | Y | Y | 5 | Y | Y | Y | Y | |
| F46 | 2Eh | 69h | Mechanical Loss Compensation | 1 | -300.00 to 300.00% | Y | 0.00 | Y | Y | 7 | Y | Y | N | Y | |
| F47 | 2Fh | 6Ah | Torque Bias T1 | 1 | -300.00 to 300.00%<br>Torque biases T1 to T3 are switchable with DI. | Y | 0.00 | Y | Y | 7 | Y | Y | N | Y | |
| F48 | 30h | h | Torque Bias T2 | 1 | -300.00 to 300.00% | Y | 0.00 | Y | Y | 7 | Y | Y | N | Y | |
| F49 | 31h | h | Torque Bias T3 | 1 | -300.00 to 300.00% | Y | 0.00 | Y | Y | 7 | Y | Y | N | Y | |
| F50 | 32h | h | Torque Bias Startup Timer | 1 | 0.00 to 1.00 s<br>F50 specifies the time required for generating 300% torque. | Y | 0.00 | Y | Y | 3 | Y | Y | N | Y | |
| F51 | 33h | FBh | Torque Command Monitor (Polarity) | 1 | 0 or 1<br>0: Torque polarity<br>1: + for driving, - for braking<br>F51 specifies the polarity of torque related data output (e.g., Ao monitor, LED monitor, and LCD monitor). | Y | 0 | Y | Y | 48 | Y | Y | Y | Y | |

| Function code | Communications address: 485 No. | Communications address: Link No. | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control: VC w/ PG | Drive control: VC w/o PG | Drive control: V/f | Drive control: VC for PMSM | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F52 | 34h | h | LED Monitor (Display coefficient A) | 8 | -999.00 to 999.00<br>F52 specifies the conversion coefficient for displaying the load shaft speed and line speed on the LED monitor.<br>Display value = Motor speed x (0.01 to 200.00)<br>Only the setting range from 0.01 to 200.00 takes effect. The specification out of the range is limited. | Y | 1.00 | Y | Y | 12 | Y | Y | Y | Y | |
| F53 | 35h | h | (Display coefficient B) | 1 | -999.00 to 999.00<br>Display coefficient A: Maximum value<br>Display coefficient B: Minimum value<br>F52 and F53 specify the conversion coefficients for displaying the PID command, PID feedback amount, and PID output (process command).<br>Display value = (Command or feedback value) x (Display coefficient A - B) + B | Y | 1.00 | Y | Y | 12 | Y | Y | Y | Y | |
| F54 | 36h | h | LED Monitor (Display filter) | 1 | 0.0 to 5.0 s | Y | 0.2 | Y | Y | 2 | Y | Y | Y | Y | |
| F55 | 37h | h | (Item selection) | 1 | 0 to 32 | Y | 0 | Y | Y | 49 | | | | | |
| | | | | | 0: Detected speed 1 or Reference speed 4 (r/min) (switchable with F56) | | | | | | Y | Y | N | Y | |
| | | | | | 1: Reference speed 4 (ASR input) (r/min) | | | | | | Y | Y | Y | Y | |
| | | | | | 2: Output frequency (after slip compensation) (Hz) | | | | | | Y | Y | Y | Y | |
| | | | | | 3: Reference torque current (%) | | | | | | Y | Y | N | Y | |
| | | | | | 4: Reference torque (%) | | | | | | Y | Y | N | Y | |
| | | | | | 5: Calculated torque (%) | | | | | | Y | Y | Y | Y | |
| | | | | | 6: Power consumption (Motor output) (kW or HP, switchable with F60) | | | | | | Y | Y | Y | Y | |
| | | | | | 7: Output current (A) | | | | | | Y | Y | Y | Y | |
| | | | | | 8: Output voltage (V) | | | | | | Y | Y | Y | Y | |
| | | | | | 9: DC link bus voltage (V) | | | | | | Y | Y | Y | Y | |
| | | | | | 10: Magnetic flux command (%) | | | | | | Y | Y | N | N | |
| | | | | | 11: Calculated magnetic flux (%) | | | | | | Y | Y | N | N | |
| | | | | | 12: Motor temperature (℃) (When no NTC thermistor is used, "---" appears.) | | | | | | Y | Y | Y | Y | |
| | | | | | 13: Load shaft speed (r/min) (Detected or commanded, switchable with F56) | | | | | | Y | Y | N | Y | |
| | | | | | 14: Line speed (m/min) (Detected or commanded, switchable with F56) | | | | | | Y | Y | Y | Y | |
| | | | | | 15: Ai adjustment value on [12] (%) | | | | | | Y | Y | Y | Y | |
| | | | | | 16: Ai adjustment value on [Ai1] (%) | | | | | | Y | Y | Y | Y | |
| | | | | | 17: Ai adjustment value on [Ai2] (%) | | | | | | Y | Y | Y | Y | |
| | | | | | 18: Ai adjustment value on [Ai3] (%) | | | | | | Y | Y | Y | Y | |
| | | | | | 19: Ai adjustment value on [Ai4] (%) | | | | | | Y | Y | Y | Y | |
| | | | | | The following data will be hidden depending upon the mode or options.<br>20: PID command (%) | | | | | | Y | Y | Y | Y | |
| | | | | | 21: PID feedback amount (%) | | | | | | Y | Y | Y | Y | |
| | | | | | 22: PID output (%) | | | | | | Y | Y | Y | Y | |
| | | | | | 23: Option monitor 1 (HEX) | | | | | | Y | Y | Y | Y | |
| | | | | | 24: Option monitor 2 (HEX) | | | | | | Y | Y | Y | Y | |
| | | | | | 25: Option monitor 3 (DEC) | | | | | | Y | Y | Y | Y | |
| | | | | | 26: Option monitor 4 (DEC) | | | | | | Y | Y | Y | Y | |
| | | | | | 27: Option monitor 5 (DEC) | | | | | | Y | Y | Y | Y | |
| | | | | | 28: Option monitor 6 (DEC) | | | | | | Y | Y | Y | Y | |
| | | | | | 29: - | | | | | | Y | Y | Y | Y | |
| | | | | | 30: Load factor (%) | | | | | | Y | Y | Y | Y | |
| | | | | | 31: Input power (kW or HP, switchable with F60) | | | | | | Y | Y | Y | Y | |
| | | | | | 32: Input watt-hour (x 100 kWh) | | | | | | Y | Y | Y | Y | |
| F56 | 38h | h | (Display when stopped) | 1 | 0 or 1<br>0: Reference speed<br>1: Detected speed<br>F56 switches the display data between the reference speed and detected one when the motor stops. It applies to the speed (F55 = 0), the load shaft speed (F55 = 13), and the line speed (F55 = 14). | Y | 0 | Y | Y | 50 | Y | Y | Y | Y | |

| Function code | Communications address: 485 No. | Communications address: Link No. | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control: VC w/ PG | Drive control: VC w/o PG | Drive control: V/f | Drive control: VC for PMSM | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F57 | 39h | h | LCD Monitor (Item selection) | 1 | 0 or 1<br>0: Running status, rotational direction and operation guide<br>1: Bar charts for detected speed 1, current and reference torque<br>F57 switches the Running mode screen. | Y | 0 | Y | Y | 51 | Y | Y | Y | Y | |
| F58 | 3Ah | h | (Language selection) | 1 | 0 to 7<br>0: Japanese<br>1: English<br>2: German (Available soon)<br>3: French (Available soon)<br>4: Spanish (Available soon)<br>5: Italian (Available soon)<br>6: Chinese<br>7: Korean | Y | 0 | Y | Y | 52 | Y | Y | Y | Y | |
| F59 | 3Bh | | (Contrast control) | 1 | 0 (Low) to 10 (High) | Y | 5 | Y | Y | 0 | Y | Y | Y | Y | |
| F60 | 3Ch | | Output Unit (HP/kW) | 0 | 0 or 1<br>0: kW<br>1: HP<br>F60 switches the display unit between kW and HP on the LED monitor and LCD monitor for the power consumption (F55 = 6) and input power (F55 = 31). It also switches the display table between kW and HP for motor 1 selection (P02). | Y | 0 | Y | Y | 53 | Y | Y | Y | Y | |
| F61 | 3Dh | 6Bh | ASR1 (P-gain) | 10 | 0.1 to 500.0 times | Y | 10.0 | Y | Y | 2 | Y | Y | N | Y | |
| F62 | 3Eh | 6Ch | (Integral constant) | 1 | 0.000 to 10.000 s<br>P control when F62 = 0.000 | Y | 0.200 | Y | Y | 4 | Y | Y | N | Y | |
| F63 | 3Fh | 6Dh | (Feedforward gain) | 1 | 0.000 to 9.999 s | Y | 0.000 | Y | Y | 4 | Y | Y | N | Y | |
| F64 | 40h | 6Eh | (Input filter) | 1 | 0.000 to 5.000 s | Y | 0.040 | Y | Y | 4 | Y | Y | Y | Y | |
| F65 | 41h | 6Fh | (Detection filter) | 1 | 0.000 to 0.100 s<br>F65 specifies a time constant of the first order delay filter for detected speed. | Y | 0.005 | Y | Y | 4 | Y | Y | N | Y | |
| F66 | 42h | 70h | (Output filter) | 1 | 0.000 to 0.100 s<br>F66 specifies a time constant of the first order delay filter for torque command. | N | 0.002 | Y | Y | 4 | Y | Y | N | Y | |
| F67 | 43h | 71h | S-curve Acceleration 1 (Start) | 1 | 0 to 50% | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| F68 | 44h | 72h | (End) | 1 | 0 to 50% | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| F69 | 45h | 73h | S-curve Deceleration 1 (Start) | 1 | 0 to 50% | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| F70 | 46h | 74h | (End) | 1 | 0 to 50% | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| F72 | 48h | h | Pre-excitation Mode | 4 | 0 or 1<br>0: Cause pre-excitation at the time of startup (Pre-excitation continues for the duration specified by F74.)<br>1: Cause pre-excitation at the time of startup and stop. (Pre-excitation continues for the duration specified by F74 or until the magnetic flux command reaches the detection level specified by E48, whichever is earlier.) | N | 0 | Y | Y | 230 | Y | Y | N | N | |
| F73 | 49h | h | Magnetic Flux Level at Light Load | 1 | 10 to 100% | Y | 100 | Y | Y | 16 | Y | N | N | N | |
| F74 | 4Ah | 75h | Pre-excitation (Duration) | 1 | 0.0 to 10.0 s<br>Turning a run command (FWD, REV) ON automatically continues pre-excitation for the duration specified by F74. | N | 0.0 | Y | Y | 2 | Y | Y | N | N | |
| F75 | 4Bh | 76h | (Initial level) | 1 | 100 to 400% | N | 100 | Y | Y | 0 | Y | Y | N | N | |
| F76 | 4Ch | h | Speed Limiter (Mode) | 3 | 0 to 3<br>0: Level 1 for forward rotation, Level 2 for reverse rotation<br>1: Level 1 for both forward and reverse rotations<br>2: Level 1 for upper limit, Level 2 for lower limit<br>3: Level 1 for forward rotation, Level 2 for reverse rotation<br>(Terminal [12] input added as a bias) | N | 0 | Y | Y | 91 | Y | Y | Y | Y | |
| F77 | 4Dh | 4Fh | (Level 1) | 1 | -110.0 to 110.0% | Y | 100.0 | Y | Y | 6 | Y | Y | Y | Y | |
| F78 | 4Eh | FEh | (Level 2) | 1 | -110.0 to 110.0% | Y | 100.0 | Y | Y | 6 | Y | Y | Y | Y | |
| F79 | 4Fh | 77h | Motor Selection (M1, M2, M3) | 0 | 0 to 2<br>0: Select M1 (Note that switching of contacts by X terminal functions has priority over this function code setting.)<br>1: Select M2 (X terminal functions disabled)<br>2: Select M3 (X terminal functions disabled)<br>Select a motor to be used from M1, M2 and M3. | N | 0 | Y | N | 54 | Y | Y | Y | Y | |

| Function code | Communications address: 485 No. | Communications address: Link No. | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control: VC w/ PG | Drive control: VC w/o PG | Drive control: V/f | Drive control: VC for PMSM | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F80 | 50h | h | Switching between HD, MD and LD Drive Modes | 0 | 0 to 3<br>0, 2: HD (High duty mode, overload capability 150%/200%)<br>1: LD (Low duty mode, overload capability 120%)<br>3: MD (Medium duty mode, overload capability 150%)<br>F80 switches the drive mode between the HD, MD and LD. | N | 0 | Y | N | 56 | Y | Y | Y | Y | |
| F81 | 51h | h | Offset for Speed Setting on Terminal [12] | 3 | -30000 to 30000 r/min<br>F81 specifies the offset speed adjustment for analog speed setting on terminal [12]. | Y | 0 | Y | Y | 5 | Y | Y | Y | Y | |
| F82 | 52h | h | Dead Zone for Speed Setting on Terminal [12] | 1 | 0.0 to 150.0 r/min<br>F82 specifies the dead zone for analog speed setting on terminal [12] to limit the ±speed setting specified by F82 to 0 r/min. | Y | 0 | Y | Y | 2 | Y | Y | Y | Y | |
| F83 | 53h | h | Filter for Speed Setting on Terminal [12] | 1 | 0.000 to 5.000 s | Y | 0.005 | Y | Y | 4 | Y | Y | Y | Y | |
| F84 | 54h | h | Display Coefficient for Input Watt-hour Data | 0 | 0.000 to 9999<br>F84 specifies a display coefficient for displaying the input watt-hour data (M116).<br>M116 = F84 x M115 (Input watt-hour, kWh)<br>Specification of 0.000 clears the input watt-hour data. | Y | 0.010 | Y | Y | 101 | Y | Y | Y | Y | |
| F85 | 55h | h | Display Filter for Calculated Torque | 0 | 0.000 to 1.000 s<br>F85 specifies a display filter for calculated torque output for monitoring (LED monitor and LCD monitor). | Y | 0.100 | Y | Y | 4 | Y | Y | Y | Y | |

### 5.3.2 E codes (Extension Terminal Functions)

| Function code | Communications address: 485 No. | Communications address: Link No. | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control: VC w/ PG | Drive control: VC w/o PG | Drive control: V/f | Drive control: VC for PMSM | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E01 | 101h | 78h | Terminal [X1] Function | 13 | 0 to 79 | N | 0 | Y | Y | 57 | | | | | |
| | | | | | 0, 1, 2, 3: Select multistep speed (1 to 15 steps) 0: ***SS1***, 1: ***SS2***, 2: ***SS4***, 3: ***SS8*** | | | | | | Y | Y | Y | Y | |
| | | | | | 4,5: Select ASR and ACC/DEC time (4 steps) 4: ***RT1***, 5: ***RT2*** | | | | | | Y | Y | Y | Y | |
| | | | | | 6: Enable 3-wire operation ***HLD*** | | | | | | Y | Y | Y | Y | |
| | | | | | 7: Coast to a stop ***BX*** | | | | | | Y | Y | Y | Y | |
| | | | | | 8: Reset alarm ***RST*** | | | | | | Y | Y | Y | Y | |
| | | | | | 9: Enable external alarm trip ***THR*** | | | | | | Y | Y | Y | Y | |
| | | | | | 10: Ready for jogging ***JOG*** | | | | | | Y | Y | Y | Y | |
| | | | | | 11: Select speed command N2/N1 ***N2/N1*** | | | | | | Y | Y | Y | Y | |
| | | | | | 12: Select motor 2 ***M-CH2*** | | | | | | Y | Y | Y | Y | |
| | | | | | 13: Select motor 3 ***M-CH3*** | | | | | | Y | Y | Y | Y | |
| | | | | | 14: Enable DC braking ***DCBRK*** | | | | | | Y | Y | Y | N | |
| | | | | | 15: Clear ACC/DEC to zero ***CLR*** | | | | | | Y | Y | Y | Y | |
| | | | | | 16: Switch creep speed under UP/DOWN control ***CRP-N2/N1*** | | | | | | Y | Y | Y | Y | |
| | | | | | 17: UP (Increase speed) ***UP*** | | | | | | Y | Y | Y | Y | |
| | | | | | 18: DOWN (Decrease speed) ***DOWN*** | | | | | | Y | Y | Y | Y | |
| | | | | | 19: Enable data change with keypad ***WE-KP*** | | | | | | Y | Y | Y | Y | |
| | | | | | 20: Cancel PID control ***KP/PID*** | | | | | | Y | Y | Y | Y | |
| | | | | | 21: Switch normal/inverse operation ***IVS*** | | | | | | Y | Y | Y | Y | |
| | | | | | 22: Interlock (52-2) ***IL*** | | | | | | Y | Y | Y | Y | |
| | | | | | 23: Enable data change via communications link ***WE-LK*** | | | | | | Y | Y | Y | Y | |
| | | | | | 24: Enable communications link ***LE*** | | | | | | Y | Y | Y | Y | |
| | | | | | 25: Universal DI ***U-DI*** | | | | | | Y | Y | Y | Y | |
| | | | | | 26: Enable auto search for idling motor speed at starting ***STM*** | | | | | | Y | Y | N | Y | |
| | | | | | 27: Synchronous operation command (PG (PR) optional function) ***SYC*** | | | | | | Y | N | N | Y | |
| | | | | | 28: Lock at zero speed ***LOCK*** | | | | | | Y | N | N | Y | |
| | | | | | 29: Pre-excitation ***EXITE*** | | | | | | Y | Y | N | N | |
| | | | | | 30: Cancel speed limiter ***N-LIM*** (Related codes: F76, F77, F78) | | | | | | Y | Y | Y | Y | |
| | | | | | 31: Cancel H41 (Torque command) ***H41-CCL*** | | | | | | Y | Y | N | Y | |
| | | | | | 32: Cancel H42 (Torque current command) ***H42-CCL*** | | | | | | Y | Y | N | Y | |
| | | | | | 33: Cancel H43 (Magnetic flux command) ***H43-CCL*** | | | | | | Y | N | N | N | |
| | | | | | 34: Cancel F40 (Torque limiter mode 1) ***F40-CCL*** | | | | | | Y | Y | N | Y | |
| | | | | | 35: Select torque limiter level 2/1 ***TL2/TL1*** | | | | | | Y | Y | N | Y | |
| | | | | | 36: Bypass ACC/DEC processor ***BPS*** | | | | | | Y | Y | Y | Y | |
| | | | | | 37, 38: Select torque bias command 37: ***TB1***, 38: ***TB2*** | | | | | | Y | Y | N | Y | |
| | | | | | 39: Select droop control ***DROOP*** | | | | | | Y | Y | N | Y | |
| | | | | | 40: Zero-hold Ai1 ***ZH-AI1*** | | | | | | Y | Y | Y | Y | |
| | | | | | 41: Zero-hold Ai2 ***ZH-AI2*** | | | | | | Y | Y | Y | Y | |
| | | | | | 42: Zero-hold Ai3 (AIO optional function) ***ZH-AI3*** | | | | | | Y | Y | Y | Y | |
| | | | | | 43: Zero-hold Ai4 (AIO optional function) ***ZH-AI4*** | | | | | | Y | Y | Y | Y | |
| | | | | | 44: Reverse Ai1 polarity ***REV-AI1*** | | | | | | Y | Y | Y | Y | |
| | | | | | 45: Reverse Ai2 polarity ***REV-AI2*** | | | | | | Y | Y | Y | Y | |
| | | | | | 46: Reverse Ai3 polarity (AIO optional function) ***REV-AI3*** | | | | | | Y | Y | Y | Y | |
| | | | | | 47: Reverse Ai4 polarity (AIO optional function) ***REV-AI4*** | | | | | | Y | Y | Y | Y | |
| | | | | | 48: Inverse PID output ***PID-INV*** | | | | | | Y | Y | Y | Y | |
| | | | | | 49: Cancel PG alarm ***PG-CCL*** | | | | | | Y | N | N | Y | |
| | | | | | 50: Cancel undervoltage alarm ***LU-CCL*** | | | | | | Y | Y | Y | Y | |
| | | | | | 51: Hold Ai torque bias ***H-TB*** | | | | | | Y | Y | N | Y | |
| | | | | | 52: STOP1 ***STOP1*** (Decelerate to stop with normal deceleration time) | | | | | | Y | Y | Y | Y | |
| | | | | | 53: STOP2 ***STOP2*** (Decelerate to stop with deceleration time 4) | | | | | | Y | Y | Y | Y | |
| | | | | | 54: STOP3 ***STOP3*** (Decelerate to stop with max. braking torque, ignoring the deceleration time setting) | | | | | | Y | Y | Y | Y | |
| | | | | | 55: Latch DIA data (DIA optional function) ***DIA*** | | | | | | Y | Y | Y | Y | |
| | | | | | 56: Latch DIB data (DIB optional function) ***DIB*** | | | | | | Y | Y | Y | Y | |

| Function code | Communications address | | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 485 No. | Link No. | | | | | | | | | VC w/ PG | VC w/o PG | V/f | VC for PMSM | |
| E01 | 101h | 78h | Terminal [X1] Function | 13 | 57: Cancel multiplex system ***MT-CCL*** | | | | | | Y | N | N | N | |
| | | | | | 58-67: Custom Di1-Di10 ***C-DI1*** to ***C-DI10*** | | | | | | Y | Y | Y | Y | |
| | | | | | 68: Select load adaptive parameters 2/1 (Available soon) ***AN-P2/1*** | | | | | | Y | N | N | Y | |
| | | | | | 69: Cancel PID components ***PID-CCL*** | | | | | | Y | Y | Y | Y | |
| | | | | | 70: Enable PID FF component ***PID-FF*** | | | | | | Y | Y | Y | Y | |
| | | | | | 71: Reset completion of speed limit calculation (Available soon) ***NL-RST*** | | | | | | Y | Y | Y | Y | |
| | | | | | 72: Toggle signal 1 ***TGL1*** | | | | | | Y | Y | Y | Y | |
| | | | | | 73: Toggle signal 2 ***TGL2*** | | | | | | Y | Y | Y | Y | |
| | | | | | 74: Cause external mock alarm ***FTB*** | | | | | | Y | Y | Y | Y | |
| | | | | | 75: Cancel NTC thermistor alarm ***NTC-CCL*** | | | | | | Y | Y | Y | Y | |
| | | | | | 76: Cancel lifetime alarm signal ***LF-CCL*** | | | | | | Y | Y | Y | Y | |
| | | | | | 77: - | | | | | | - | - | - | - | |
| | | | | | 78: Switch PID feedback signals ***PID-1/2*** | | | | | | Y | Y | Y | Y | |
| | | | | | 79: Select PID torque bias ***TB-PID*** | | | | | | Y | Y | Y | Y | |
| | | | | | 80: Tune magnetic pole position (Available soon) ***MP-TUN*** | | | | | | N | N | N | Y | |
| E02 | 102h | 79h | Terminal [X2] Function | 1 | 0 to 79 (See Terminal [X1] Function.) | N | 1 | Y | Y | 57 | Y | Y | Y | Y | |
| E03 | 103h | 7Ah | Terminal [X3] Function | 1 | 0 to 79 (See Terminal [X1] Function.) | N | 2 | Y | Y | 57 | Y | Y | Y | Y | |
| E04 | 104h | 7Bh | Terminal [X4] Function | 1 | 0 to 79 (See Terminal [X1] Function.) | N | 3 | Y | Y | 57 | Y | Y | Y | Y | |
| E05 | 105h | 7Ch | Terminal [X5] Function | 1 | 0 to 79 (See Terminal [X1] Function.) | N | 4 | Y | Y | 57 | Y | Y | Y | Y | |
| E06 | 106h | 7Dh | Terminal [X6] Function | 1 | 0 to 79 (See Terminal [X1] Function.) | N | 5 | Y | Y | 57 | Y | Y | Y | Y | |
| E07 | 107h | 7Eh | Terminal [X7] Function | 1 | 0 to 79 (See Terminal [X1] Function.) | N | 7 | Y | Y | 57 | Y | Y | Y | Y | |
| E08 | 108h | 7Fh | Terminal [X8] Function | 1 | 0 to 79 See Terminal [X1] Function.) | N | 8 | Y | Y | 57 | Y | Y | Y | Y | |
| E09 | 109h | 80h | Terminal [X9] Function | 1 | 0 to 79 (See Terminal [X1] Function.) | N | 9 | Y | Y | 57 | Y | Y | Y | Y | |
| E10 | 10Ah | 81h | Terminal [X11] Function | 1 | 0 to 79 (See Terminal [X1] Function.) | N | 25 | Y | Y | 57 | Y | Y | Y | Y | |
| E11 | 10Bh | 82h | Terminal [X12] Function | 1 | 0 to 79 (See Terminal [X1] Function.) | N | 25 | Y | Y | 57 | Y | Y | Y | Y | |
| E12 | 10Ch | 83h | Terminal [X13] Function | 1 | 0 to 79 (See Terminal [X1] Function.) | N | 25 | Y | Y | 57 | Y | Y | Y | Y | |
| E13 | 10Dh | 84h | Terminal [X14] Function | 1 | 0 to 79 (See Terminal [X1] Function.) | N | 25 | Y | Y | 57 | Y | Y | Y | Y | |
| E14 | 10Eh | h | X Terminal Function (Normal open/close) | 0 | 0000 to 01FF<br>0: Normal open<br>1: Normal close<br>E14 specifies whether to open or close the contact for terminals [X1] to [X9]. | N | 0000 | Y | Y | 35 | Y | Y | Y | Y | |
| E15 | 10Fh | 85h | Terminal [Y1] Function | 13 | 0 to 84 | N | 1 | Y | Y | 58 | | | | | |
| | | | | | 0: Inverter running ***RUN*** | | | | | | Y | Y | Y | Y | |
| | | | | | 1: Speed valid ***N-EX*** | | | | | | Y | Y | Y | Y | |
| | | | | | 2: Speed agreement 1 ***N-AG1*** | | | | | | Y | Y | N | Y | |
| | | | | | 3: Speed arrival signal ***N-AR*** | | | | | | Y | Y | Y | Y | |
| | | | | | 4: Speed detected 1 ***N-DT1*** | | | | | | Y | Y | Y | Y | |
| | | | | | 5: Speed detected 2 ***N-DT2*** | | | | | | Y | Y | Y | Y | |
| | | | | | 6: Speed detected 3 ***N-DT3*** | | | | | | Y | Y | Y | Y | |
| | | | | | 7: Undervoltage detected (Inverter stopped) ***LU*** | | | | | | Y | Y | Y | Y | |
| | | | | | 8: Torque polarity detected (braking/driving) ***B/D*** | | | | | | Y | Y | N | Y | |
| | | | | | 9: Torque limiting ***TL*** | | | | | | Y | Y | Y | Y | |
| | | | | | 10: Torque detected 1 ***T-DT1*** | | | | | | Y | Y | Y | Y | |
| | | | | | 11: Torque detected 2 ***T-DT2*** | | | | | | Y | Y | Y | Y | |
| | | | | | 12: Keypad operation enabled ***KP*** | | | | | | Y | Y | Y | Y | |
| | | | | | 13: Inverter stopped ***STOP*** | | | | | | Y | Y | Y | Y | |
| | | | | | 14: Inverter ready to run ***RDY*** | | | | | | Y | Y | Y | Y | |
| | | | | | 15: Magnetic flux detected ***MF-DT*** | | | | | | Y | Y | N | N | |
| | | | | | 16: Motor M2 selected ***SW-M2*** | | | | | | Y | Y | Y | Y | |
| | | | | | 17: Motor M3 selected ***SW-M3*** | | | | | | Y | Y | Y | Y | |
| | | | | | 18: Brake release signal ***BRK*** | | | | | | Y | Y | N | Y | |
| | | | | | 19: Alarm content 1 ***AL1*** | | | | | | Y | Y | Y | Y | |
| | | | | | 20: Alarm content 2 ***AL2*** | | | | | | Y | Y | Y | Y | |
| | | | | | 21: Alarm content 4 ***AL4*** | | | | | | Y | Y | Y | Y | |
| | | | | | 22: Alarm content 8 ***AL8*** | | | | | | Y | Y | Y | Y | |
| | | | | | 23: Cooling fan in operation ***FAN*** | | | | | | Y | Y | Y | Y | |
| | | | | | 24: Resetting ***TRY*** | | | | | | Y | Y | Y | Y | |
| | | | | | 25: Universal DO ***U-DO*** | | | | | | Y | Y | Y | Y | |

| Function code | Communications address: 485 No. | Communications address: Link No. | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control: VC w/ PG | Drive control: VC w/o PG | Drive control: V/f | Drive control: VC for PMSM | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E15 | 10Fh | 85h | Terminal [Y1] Function | 13 | 26: Heat sink overheat early warning ***INV-OH*** | | | | | | Y | Y | Y | Y | |
| | | | | | 27: Synchronization completion signal ***SY-C*** | | | | | | Y | N | N | Y | |
| | | | | | 28: Lifetime alarm ***LIFE*** | | | | | | Y | Y | Y | Y | |
| | | | | | 29: Under acceleration ***U-ACC*** | | | | | | Y | Y | Y | Y | |
| | | | | | 30: Under deceleration ***U-DEC*** | | | | | | Y | Y | Y | Y | |
| | | | | | 31: Inverter overload early warning ***INV-OL*** | | | | | | Y | Y | Y | Y | |
| | | | | | 32: Motor overheat early warning ***M-OH*** | | | | | | Y | Y | Y | Y | |
| | | | | | 33: Motor overload early warning ***M-OL*** | | | | | | Y | Y | Y | Y | |
| | | | | | 34: DB overload early warning ***DB-OL*** | | | | | | Y | Y | N | Y | |
| | | | | | 35: Link transmission error ***LK-ERR*** | | | | | | Y | Y | Y | Y | |
| | | | | | 36: In limiting under load adaptive control ***ANL*** | | | | | | Y | N | N | Y | |
| | | | | | 37: In calculation under load adaptive control ***ANC*** | | | | | | Y | N | N | Y | |
| | | | | | 38: Analog torque bias being held ***TBH*** | | | | | | Y | Y | N | Y | |
| | | | | | 39 to 48: Custom Do1-Do10 ***C-DO1*** to ***C-DO10*** | | | | | | Y | Y | Y | Y | |
| | | | | | 49: - | | | | | | - | - | - | - | |
| | | | | | 50: Z-phase detection completed(Available soon) ***Z-RDY*** | | | | | | Y | N | N | Y | |
| | | | | | 51: Multiplex system communications link being established ***MTS*** | | | | | | Y | N | N | N | |
| | | | | | 52: Multiplex system cansel response ***MEC-AB*** | | | | | | Y | N | N | N | |
| | | | | | 53: Multiplex system master selected ***MSS*** | | | | | | Y | N | N | N | |
| | | | | | 54: Multiplex system local station failure ***AL-SF*** | | | | | | Y | N | N | N | |
| | | | | | 55: Stopped due to communications link error (Available soon) ***LES*** | | | | | | Y | Y | Y | Y | |
| | | | | | 56: Alarm output (for any alarm) ***ALM*** | | | | | | Y | Y | Y | Y | |
| | | | | | 57: Light alarm ***L-ALM*** | | | | | | Y | Y | Y | Y | |
| | | | | | 58: Maintenance timer ***MNT*** | | | | | | Y | Y | Y | Y | |
| | | | | | 59: Braking transistor broken ***DBAL*** | | | | | | Y | Y | Y | Y | |
| | | | | | 60: DC fan locked ***DCFL*** | | | | | | Y | Y | Y | Y | |
| | | | | | 61: Speed agreement 2 ***N-AG2*** | | | | | | Y | Y | N | Y | |
| | | | | | 62: Speed agreement 3 ***N-AG3*** | | | | | | Y | Y | N | Y | |
| | | | | | 63: Axial fan stopped ***MFAN*** | | | | | | Y | Y | Y | Y | |
| | | | | | 64: Assign ready(Available soon) ***AS-RDY*** | | | | | | - | - | - | - | |
| | | | | | 65: - | | | | | | - | - | - | - | |
| | | | | | 66: Answerback to droop control enabled ***DSAB*** | | | | | | Y | Y | N | Y | |
| | | | | | 67: Answerback to cancellation of torque command/torque current command (***H41-CCL***/***H42-CCL***) ***TCL-C*** | | | | | | Y | Y | N | Y | |
| | | | | | 68: Answerback to cancellation of torque limiter mode 1 (F40-CCL) ***F40-AB*** | | | | | | Y | Y | Y | Y | |
| | | | | | 69: - | | | | | | - | - | - | - | |
| | | | | | 70: - | | | | | | - | - | - | - | |
| | | | | | 71: 73 ON command ***PRT-73*** | | | | | | Y | Y | Y | Y | |
| | | | | | 72: Turn ON Y-terminal test output ***Y-ON*** | | | | | | Y | Y | Y | Y | |
| | | | | | 73: Turn OFF Y-terminal test output ***Y-OFF*** | | | | | | Y | Y | Y | Y | |
| | | | | | 74: - | | | | | | - | - | - | - | |
| | | | | | 75: System clock battery lifetime expired ***BATT*** | | | | | | Y | Y | Y | Y | |
| | | | | | 76: Magnetic position tuning in progress (Available soon) ***TUN-MG*** | | | | | | N | N | N | Y | |
| | | | | | 77: SPGT battery warning (Available soon) ***SPGT-B*** | | | | | | Y | Y | Y | Y | |
| | | | | | 78: - | | | | | | - | - | - | - | |
| | | | | | 79: - | | | | | | - | - | - | - | |
| | | | | | 80: EN terminal detection circuit failure ***DECF*** | | | | | | Y | Y | Y | Y | |
| | | | | | 81: EN terminal OFF ***ENOFF*** | | | | | | Y | Y | Y | Y | |
| | | | | | 82: Safety function in progress ***SF-RUN*** | | | | | | Y | Y | Y | Y | |
| | | | | | 83: - | | | | | | - | - | - | - | |
| | | | | | 84: STO under testing by safety function ***SF-TST*** | | | | | | Y | Y | Y | Y | |
| E16 | 110h | 86h | Terminal [Y2] Function | 1 | 0 to 84 (See Terminal [Y1] Function.) | N | 2 | Y | Y | 58 | Y | Y | Y | Y | |
| E17 | 111h | 87h | Terminal [Y3] Function | 1 | 0 to 84 (See Terminal [Y1] Function.) | N | 3 | Y | Y | 58 | Y | Y | Y | Y | |
| E18 | 112h | 88h | Terminal [Y4] Function | 1 | 0 to 84 (See Terminal [Y1] Function.) | N | 4 | Y | Y | 58 | Y | Y | Y | Y | |
| E19 | 113h | 89h | Terminal [Y5] Function | 1 | 0 to 84 (See Terminal [Y1] Function.) | N | 14 | Y | Y | 58 | Y | Y | Y | Y | |

| Function code | Communications address | | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 485 No. | Link No. | | | | | | | | | VC w/ PG | VC w/o PG | V/f | VC for PMSM | |
| E20 | 114h | 8Ah | Terminal [Y11] Function | 1 | 0 to 84 (See Terminal [Y1] Function.) | N | 26 | Y | Y | 58 | Y | Y | Y | Y | |
| E21 | 115h | 8Bh | Terminal [Y12] Function | 1 | 0 to 84 (See Terminal [Y1] Function.) | N | 26 | Y | Y | 58 | Y | Y | Y | Y | |
| E22 | 116h | 8Ch | Terminal [Y13] Function | 1 | 0 to 84 (See Terminal [Y1] Function.) | N | 26 | Y | Y | 58 | Y | Y | Y | Y | |
| E23 | 117h | 8Dh | Terminal [Y14] Function | 1 | 0 to 84 (See Terminal [Y1] Function.) | N | 26 | Y | Y | 58 | Y | Y | Y | Y | |
| E24 | 118h | 8Eh | Terminal [Y15] Function | 1 | 0 to 84 (See Terminal [Y1] Function.) | N | 26 | Y | Y | 58 | Y | Y | Y | Y | |
| E25 | 119h | 8Fh | Terminal [Y16] Function | 1 | 0 to 84 (See Terminal [Y1] Function.) | N | 26 | Y | Y | 58 | Y | Y | Y | Y | |
| E26 | 11Ah | 90h | Terminal [Y17] Function | 1 | 0 to 84 (See Terminal [Y1] Function.) | N | 26 | Y | Y | 58 | Y | Y | Y | Y | |
| E27 | 11Bh | 91h | Terminal [Y18] Function | 1 | 0 to 84 (See Terminal [Y1] Function.) | N | 26 | Y | Y | 58 | Y | Y | Y | Y | |
| E28 | 11Ch | h | Y Terminal Function (Normal open/close) | 0 | 0000 to 001F<br>0: Normal open<br>1: Normal close | N | 0000 | Y | Y | 36 | Y | Y | Y | Y | |
| E29 | 11Dh | 92h | PG Pulse Output Selection | 0 | 0 to 10<br>0: No dividing<br>1: 1/2<br>2: 1/4<br>3: 1/8<br>4: 1/16<br>5: 1/32<br>6: 1/64<br>0 to 6: Internal PG input is divided before output.<br>7: Internal speed command: Pulse oscillation mode<br>8: PG (PD): Detected pulse input oscillation mode<br>9: PG (PR): Pulse command input oscillation mode<br>10: Integrated PG, PG (SD): Detected speed pulse input oscillation mode<br>7 to 10: Input pulse is arbitrarily divided before output. (AB 90° phase difference signal) | N | 0 | Y | Y | 92 | Y | N | N | Y | |
| E30 | 11Eh | h | Motor Overheat Protection (Temperature) | 8 | 50 to 200°C | Y | 150 | Y | Y | 0 | Y | Y | Y | Y | |
| E31 | 11Fh | h | Motor Overheat Early Warning (Temperature) | 1 | 50 to 200°C | Y | 75 | Y | Y | 0 | Y | Y | Y | Y | |
| E32 | 120h | CDh | M1-M3 PTC Activation Level | 1 | 0.00 to 5.00 V<br>The PTC is activated if the input voltage of the PTC terminal exceeds this activation level when the PTC thermistor is selected (P30/A31/A131 = 2). | N | 1.60 | Y | Y | 3 | Y | Y | Y | Y | |
| E33 | 121h | h | Inverter Overload Early Warning | 1 | 25 to 100% | Y | 90 | Y | Y | 0 | Y | Y | Y | Y | |
| E34 | 122h | h | Motor Overload Early Warning | 1 | 25 to 100% | Y | 90 | Y | Y | 0 | Y | Y | Y | Y | |
| E35 | 123h | h | DB Overload Protection | 1 | 0 to 100%<br>E35 specifies %ED of the braking resistor relative to the inverter capacity.<br>When E35 = 0, the overload protection function (dbH) is disabled. | Y | 0 | Y | Y | 0 | Y | Y | N | Y | |
| E36 | 124h | h | DB Overload Early Warning | 1 | 0 to 100% | Y | 80 | Y | Y | 0 | Y | Y | N | Y | |
| E37 | 125h | h | DB Thermal Time Constant | 1 | 0 to 1000 s | Y | 300 | Y | Y | 0 | Y | Y | N | Y | |
| E38 | 126h | 93h | Speed Detection Mode | 8 | 000 to 111<br>Detection mode of 0xE39/E40/E41<br>0: Detected speed<br>1: Reference speed<br>Under V/f control, only the specified reference speed is valid. | Y | 000 | Y | Y | 9 | Y | Y | N | Y | |
| E39 | 127h | 94h | Speed Detection Level 1 | 1 | 0 to 30000 r/min<br>If ***N-FB1±*** (Detected speed 1) or ***N-REF4*** (Reference speed 4) exceeds this speed detection level 1, the inverter issues the detection signal. | Y | 1500 | Y | Y | 0 | Y | Y | Y | Y | |
| E40 | 128h | 95h | Speed Detection Level 2 | 1 | -30000 to 30000 r/min | Y | 1500 | Y | Y | 5 | Y | Y | Y | Y | |
| E41 | 129h | 96h | Speed Detection Level 3 | 1 | -30000 to 30000 r/min | Y | 1500 | Y | Y | 5 | Y | Y | Y | Y | |
| E42 | 12Ah | 97h | Speed Arrival (Detection width) | 1 | 1.0 to 20.0%<br>If the detected speed comes within the range of ***N-REF2*** (Reference speed 2) ± this detection width, the inverter issues the detection signal. | Y | 3.0 | Y | Y | 2 | Y | Y | N | Y | |
| E43 | 12Bh | 98h | Speed Agreement (Detection width) | 1 | 1.0 to 20.0%<br>If ***N-FB2±*** (Detected speed 2) is within the range of ***N-REF4*** (Reference speed 4) ± this detection width, the inverter issues the detection signal. | Y | 3.0 | Y | Y | 2 | Y | Y | N | Y | |
| E44 | 12Ch | 99h | (Off-delay timer) | 1 | 0.000 to 5.000 s | Y | 0.100 | Y | Y | 4 | Y | Y | N | Y | |
| E45 | 12Dh | 9Ah | Speed Disagreement Alarm | 1 | 00 to 21<br>Units place: Speed disagreement alarm (E-9)<br>0: Disable<br>1: Enable<br>Tenths place: Power supply phase loss detection (L ⊓)<br>0: Standard level<br>1: For particular manufacturers.<br>2: Cancel | N | 00 | Y | Y | 9 | Y | Y | N | Y | |
| E46 | 12Eh | 9Bh | Torque Detection Level 1 | 3 | 0 to 300%<br>Calculated value under V/f control.<br>If the torque command exceeds this setting, the inverter issues the detection signal. | Y | 30 | Y | Y | 16 | Y | Y | Y | Y | |

| Function code | Communications address 485 No. | Communications address Link No. | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control: VC w/ PG | Drive control: VC w/o PG | Drive control: V/f | Drive control: VC for PMSM | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E47 | 12Fh | 9Ch | Torque Detection Level 2 | 1 | 0 to 300% | Y | 30 | Y | Y | 16 | Y | Y | Y | Y | |
| E48 | 130h | 9Dh | Magnetic Flux Detection Level | 1 | 10 to 100%<br>If the magnetic flux value calculated exceeds this setting, the inverter issues the detection signal. | N | 100 | Y | Y | 16 | Y | Y | N | N | |
| E49 | 131h | h | Terminal [Ai1] Function | 4 | 0 to 27 | N | 0 | Y | Y | 59 | | | | | |
| | | | | | 0: Shut down input signal ***OFF*** - | | | | | | Y | Y | Y | Y | |
| | | | | | 1: Auxiliary speed setting 1 ***AUX-N1*** ±10V/±Nmax | | | | | | Y | Y | Y | Y | |
| | | | | | 2: Auxiliary speed setting 2 ***AUX-N2*** ±10V/±Nmax | | | | | | Y | Y | Y | Y | |
| | | | | | 3: Torque limiter level 1 ***TL-REF1*** ±10V/±150% | | | | | | Y | Y | N | Y | |
| | | | | | 4: Torque limiter level 2 ***TL-REF2*** ±10V/±150% | | | | | | Y | Y | N | Y | |
| | | | | | 5: Torque bias ***TB-REF*** ±10V/±150% | | | | | | Y | Y | N | Y | |
| | | | | | 6: Torque command ***T-REF*** ±10V/±150% | | | | | | Y | Y | N | Y | |
| | | | | | 7: Torque current command ***IT-REF*** ±10V/±150% | | | | | | Y | Y | N | Y | |
| | | | | | 8: Creep speed 1 for UP/DOWN control ***CRP-N1*** ±10V/±Nmax | | | | | | Y | Y | Y | Y | |
| | | | | | 9: Creep speed 2 for UP/DOWN control ***CRP-N2*** ±10V/±Nmax | | | | | | Y | Y | Y | Y | |
| | | | | | 10: Magnetic flux reference ***MF-REF*** ＋10V/＋100% | | | | | | Y | N | N | N | |
| | | | | | 11: Detect line speed ***LINE-N*** ±10V/±Nmax | | | | | | Y | Y | Y | Y | |
| | | | | | 12: Motor temperature ***M-TMP*** ＋10V/200°C | | | | | | Y | Y | Y | Y | |
| | | | | | 13: Speed override ***N-OR*** ±10V/±50% | | | | | | Y | Y | Y | Y | |
| | | | | | 14: Universal Ai ***U-AI*** ±10V/±4000(h) | | | | | | Y | Y | Y | Y | |
| | | | | | 15: PID feedback 1 ***PID-FB1*** ±10V/±20000(d) | | | | | | Y | Y | Y | Y | |
| | | | | | 16: PID reference value ***PID-REF*** ±10V/±20000(d) | | | | | | Y | Y | Y | Y | |
| | | | | | 17: PID correction gain ***PID-G*** ±10V/±4000(h) | | | | | | Y | Y | Y | Y | |
| | | | | | 18 to 24: Custom Ai1 to Ai7 ***C-AI1*** to ***C-AI7*** | | | | | | Y | Y | Y | Y | |
| | | | | | 25: Main speed setting ***N-REFV*** ±10V/±Nmax | | | | | | Y | Y | Y | Y | |
| | | | | | 26: Current input speed setting (4-20 mADC) ***N-REFC*** ±10V/±Nmax<br>(Data 26 is available only on [Ai2].) | | | | | | Y | Y | Y | Y | |
| | | | | | 27: PID feedback amount 2 ***PID-FB2*** ±10V/±20000 (d) | | | | | | Y | Y | Y | Y | |
| E50 | 132h | h | Terminal [Ai2] Function | 1 | 0 to 27 (Refer to Terminal [Ai1] Function.) | N | 0 | Y | Y | 59 | Y | Y | Y | Y | |
| E51 | 133h | h | Terminal [Ai3] Function | 1 | 0 to 27 (Refer to Terminal [Ai1] Function.)<br>(Data 26 is available only on [Ai2].) | N | 0 | Y | Y | 59 | Y | Y | Y | Y | |
| E52 | 134h | h | Terminal [Ai4] Function | 1 | 0 to 27 (Refer to Terminal [Ai1] Function.)<br>(Data 26 is available only on [Ai2].) | N | 0 | Y | Y | 59 | Y | Y | Y | Y | |
| E53 | 135h | h | Ai1 Gain | 4 | -10.000 to 10.000 times | Y | 1.000 | Y | Y | 8 | Y | Y | Y | Y | |
| E54 | 136h | h | Ai2 Gain | 1 | -10.000 to 10.000 times | Y | 1.000 | Y | Y | 8 | Y | Y | Y | Y | |
| E55 | 137h | h | Ai3 Gain | 1 | -10.000 to 10.000 times | Y | 1.000 | Y | Y | 8 | Y | Y | Y | Y | |
| E56 | 138h | h | Ai4 Gain | 1 | -10.000 to 10.000 times | Y | 1.000 | Y | Y | 8 | Y | Y | Y | Y | |
| E57 | 139h | h | Ai1 Bias | 4 | -100.0 to 100.0% | Y | 0.0 | Y | Y | 6 | Y | Y | Y | Y | |
| E58 | 13Ah | h | Ai2 Bias | 1 | -100.0 to 100.0% | Y | 0.0 | Y | Y | 6 | Y | Y | Y | Y | |
| E59 | 13Bh | h | Ai3 Bias | 1 | -100.0 to 100.0% | Y | 0.0 | Y | Y | 6 | Y | Y | Y | Y | |
| E60 | 13Ch | h | Ai4 Bias | 1 | -100.0 to 100.0% | Y | 0.0 | Y | Y | 6 | Y | Y | Y | Y | |
| E61 | 13Dh | h | Ai1 Filter | 4 | 0.000 to 0.500 s | Y | 0.010 | Y | Y | 4 | Y | Y | Y | Y | |
| E62 | 13Eh | h | Ai2 Filter | 1 | 0.000 to 0.500 s | Y | 0.010 | Y | Y | 4 | Y | Y | Y | Y | |
| E63 | 13Fh | h | Ai3 Filter | 1 | 0.000 to 0.500 s | Y | 0.010 | Y | Y | 4 | Y | Y | Y | Y | |
| E64 | 140h | h | Ai4 Filter | 1 | 0.000 to 0.500 s | Y | 0.010 | Y | Y | 4 | Y | Y | Y | Y | |
| E65 | 141h | h | Up/Down Limiter (Ai1) | 4 | 0.00 to 60.00 s<br>E65 specifies the duration required when the inverter internal data changes from 0 V to 10 V if the voltage on terminal [Ai1] changes from 0 V to 10 V. | Y | 0.00 | Y | Y | 3 | Y | Y | Y | Y | |
| E66 | 142h | h | Up/Down Limiter (Ai2) | 1 | 0.00 to 60.00 s | Y | 0.00 | Y | Y | 3 | Y | Y | Y | Y | |
| E67 | 143h | h | Up/Down Limiter (Ai3) | 1 | 0.00 to 60.00 s | Y | 0.00 | Y | Y | 3 | Y | Y | Y | Y | |
| E68 | 144h | h | Up/Down Limiter (Ai4) | 1 | 0.00 to 60.00 s | Y | 0.00 | Y | Y | 3 | Y | Y | Y | Y | |

| Function code | Communications address: 485 No. | Communications address: Link No. | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control: VC w/ PG | Drive control: VC w/o PG | Drive control: V/f | Drive control: VC for PMSM | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E69 | 145h | h | Terminal [Ao1] Function | 5 | 0 to 40 | Y | 1 | Y | Y | 60 | | | | | |
| | | | | | 0: Detected speed 1 (Speed indicator, one-way deflection) ***N-FB1+*** ±Nmax/10V | | | | | | Y | Y | N | Y | |
| | | | | | 1: Detected speed 1 (Speed indicator, two-way deflection) ***N-FB1±*** ±Nmax/±10V | | | | | | Y | Y | N | Y | |
| | | | | | 2: Reference speed 2 (before ACC/DEC calculation) ***N-REF2*** ±Nmax/±10V | | | | | | Y | Y | Y | Y | |
| | | | | | 3: Reference speed 4 (ASR input) ***N-REF4*** ±Nmax/±10V | | | | | | Y | Y | Y | Y | |
| | | | | | 4: Detected speed 2 (ASR input) ***N-FB2±*** ±Nmax/±10V | | | | | | Y | Y | N | Y | |
| | | | | | 5: Detected line speed ***LINE-N±*** ±Nmax/±10V | | | | | | Y | Y | Y | Y | |
| | | | | | 6: Torque current command (Torque ammeter, one-way deflection) ***IT-REF±*** ±150%/±10V | | | | | | Y | Y | N | Y | |
| | | | | | 7: Torque current command (Torque ammeter, two-way deflection) ***IT-REF+*** ±150%/10V | | | | | | Y | Y | N | Y | |
| | | | | | 8: Torque command (Torque meter, two-way deflection) ***T-REF±*** ±150%/±10V | | | | | | Y | Y | N | Y | |
| | | | | | 9: Torque command (Torque meter, one-way deflection) ***T-REF+*** ±150%/10V | | | | | | Y | Y | N | Y | |
| | | | | | 10: Motor current ***I-AC*** 200%/10V | | | | | | Y | Y | Y | Y | |
| | | | | | 11: Motor voltage ***V-AC*** 200%/10V | | | | | | Y | Y | Y | Y | |
| | | | | | 12: Input power (Motor output) ***PWR*** 200%/10V | | | | | | Y | Y | Y | Y | |
| | | | | | 13: DC link bus voltage ***V-DC*** 800V/10V | | | | | | Y | Y | Y | Y | |
| | | | | | 14: +10V test voltage output ***P10*** +10 VDC equivalent | | | | | | Y | Y | Y | Y | |
| | | | | | 15: -10V test voltage output ***N10*** -10 VDC equivalent | | | | | | Y | Y | Y | Y | |
| | | | | | 16: Motor temperature ***TMP-M*** ±200°C/±10V | | | | | | Y | Y | Y | Y | |
| | | | | | 28: Torque bias balance adjustment (Available soon) ***TBL*** ±150%/±10V | | | | | | Y | Y | N | Y | |
| | | | | | 29: Torque bias gain adjustment (Available soon) ***TBG*** ±150%/±10V | | | | | | Y | Y | N | Y | |
| | | | | | 30: Universal AO ***U-AO*** - | | | | | | Y | Y | Y | Y | |
| | | | | | 31-37: Custom Ao1-Ao7 ***C-AO1*** to ***C-AO7*** | | | | | | Y | Y | Y | Y | |
| | | | | | 38: Input power ***PWR-IN*** 200%/10V | | | | | | Y | Y | Y | Y | |
| | | | | | 39: Magnetic pole position signal ***SMP*** TOP/5V | | | | | | N | N | N | Y | |
| | | | | | 40: PID output value ***PID-OUT*** ±200%/±10V | | | | | | Y | Y | Y | Y | |
| E70 | 146h | h | Terminal [Ao2] Function | 1 | 0 to 40 (Refer to Terminal [Ao1] function.) | Y | 6 | Y | Y | 60 | Y | Y | Y | Y | |
| E71 | 147h | h | Terminal [Ao3] Function | 1 | 0 to 40 (Refer to Terminal [Ao1]1 function.) | Y | 3 | Y | Y | 60 | Y | Y | Y | Y | |
| E72 | 148h | h | Terminal [Ao4] Function | 1 | 0 to 40 (Refer to Terminal [Ao1] function.) | Y | 0 | Y | Y | 60 | Y | Y | Y | Y | |
| E73 | 149h | h | Terminal [Ao5] Function | 1 | 0 to 40 (Refer to Terminal [Ao1] function.) | Y | 0 | Y | Y | 60 | Y | Y | Y | Y | |
| E74 | 14Ah | h | Ao1 Gain | 5 | -100.00 to 100.00 times | Y | 1.00 | Y | Y | 7 | Y | Y | Y | Y | |
| E75 | 14Bh | h | Ao2 Gain | 1 | -100.00 to 100.00 times | Y | 1.00 | Y | Y | 7 | Y | Y | Y | Y | |
| E76 | 14Ch | h | Ao3 Gain | 1 | -100.00 to 100.00 times | Y | 1.00 | Y | Y | 7 | Y | Y | Y | Y | |
| E77 | 14Dh | h | Ao4 Gain | 1 | -100.00 to 100.00 times | Y | 1.00 | Y | Y | 7 | Y | Y | Y | Y | |
| E78 | 14Eh | h | Ao5 Gain | 1 | -100.00 to 100.00 times | Y | 1.00 | Y | Y | 7 | Y | Y | Y | Y | |
| E79 | 14Fh | h | Ao1 Bias | 5 | -100.0 to 100.0% | Y | 0.0 | Y | Y | 6 | Y | Y | Y | Y | |
| E80 | 150h | h | Ao2 Bias | 1 | -100.0 to 100.0% | Y | 0.0 | Y | Y | 6 | Y | Y | Y | Y | |
| E81 | 151h | h | Ao3 Bias | 1 | -100.0 to 100.0% | Y | 0.0 | Y | Y | 6 | Y | Y | Y | Y | |
| E82 | 152h | h | Ao4 Bias | 1 | -100.0 to 100.0% | Y | 0.0 | Y | Y | 6 | Y | Y | Y | Y | |
| E83 | 153h | h | Ao5 Bias | 1 | -100.0 to 100.0% | Y | 0.0 | Y | Y | 6 | Y | Y | Y | Y | |
| E84 | 154h | h | Ao1-Ao5 Filter | 0 | 0.000 to 0.500 s | Y | 0.010 | Y | Y | 4 | Y | Y | Y | Y | |

| Function code | Communications address: 485 No. | Communications address: Link No. | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control: VC w/ PG | Drive control: VC w/o PG | Drive control: V/f | Drive control: VC for PMSM | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E90 | 15Ah | h | Link Command Function Selection 1 (Available soon) | 2 | 0 to 12 | Y | 0 | Y | Y | 231 | | | | | |
| | | | | | 0: Shut down input signal ***OFF*** | | | | | | Y | Y | Y | Y | |
| | | | | | 1: Auxiliary speed setting 1 ***AUX-N1*** | | | | | | Y | Y | Y | Y | |
| | | | | | 2: Auxiliary speed setting 2 ***AUX-N2*** | | | | | | Y | Y | Y | Y | |
| | | | | | 3: Torque bias level ***TB-REF*** | | | | | | Y | Y | N | Y | |
| | | | | | 4: Creep speed 1 for UP/DOWN control ***CRP-N1*** | | | | | | Y | Y | Y | Y | |
| | | | | | 5: Creep speed 2 for UP/DOWN control ***CRP-N2*** | | | | | | Y | Y | Y | Y | |
| | | | | | 6: Detect line speed ***LINE-N*** | | | | | | Y | Y | Y | Y | |
| | | | | | 7: Motor temperature ***M-TMP*** | | | | | | Y | Y | Y | Y | |
| | | | | | 8: Speed override ***N-OR*** | | | | | | Y | Y | Y | Y | |
| | | | | | 9: PID feedback amount 1 ***PID-FB1*** | | | | | | Y | Y | Y | Y | |
| | | | | | 10: PID command amount ***PID-REF*** | | | | | | Y | Y | Y | Y | |
| | | | | | 11: PID correction gain ***PID-G*** | | | | | | Y | Y | Y | Y | |
| | | | | | 12: PID feedback amount 2 ***PID-FB2*** | | | | | | Y | Y | Y | Y | |
| | | | | | 13: Observer torque FB ***OBS-TFB*** | | | | | | Y | Y | N | Y | |
| E91 | 15Bh | H | Link Command Function Selection 2 (Available soon) | 1 | 0 to 26<br>When E91 ≠ 0 (OFF), analog setting via the communications link (S17) has priority over Ai input specified by Ai function selection.<br>(Refer to the Link Command Function Selection 1.) | Y | 0 | Y | Y | 231 | Y | Y | Y | Y | |
| E101 | 1E01h | H | Ai1 Offset | 4 | -100.00 to 100.00% | Y | 0.00 | Y | Y | 7 | Y | Y | Y | Y | |
| E102 | 1E02h | H | Ai2 Offset | 1 | -100.00 to 100.00% | Y | 0.00 | Y | Y | 7 | Y | Y | Y | Y | |
| E103 | 1E03h | H | Ai3 Offset | 1 | -100.00 to 100.00% | Y | 0.00 | Y | Y | 7 | Y | Y | Y | Y | |
| E104 | 1E04h | h | Ai4 Offset | 1 | -100.00 to 100.00% | Y | 0.00 | Y | Y | 7 | Y | Y | Y | Y | |
| E105 | 1E05h | h | Ai1 Dead Zone | 4 | 0.00 to 10.00%<br>Limits all command values except input values to 0 V. | Y | 0.00 | Y | Y | 3 | Y | Y | Y | Y | |
| E106 | 1E06h | h | Ai2 Dead Zone | 1 | 0.00 to 10.00% | Y | 0.00 | Y | Y | 3 | Y | Y | Y | Y | |
| E107 | 1E07h | h | Ai3 Dead Zone | 1 | 0.00 to 10.00% | Y | 0.00 | Y | Y | 3 | Y | Y | Y | Y | |
| E108 | 1E08h | h | Ai4 Dead Zone | 1 | 0.00 to 10.00% | Y | 0.00 | Y | Y | 3 | Y | Y | Y | Y | |
| E109 | 1E09h | h | Dividing Ratio for FA, FB Pulse Output (Numerator) | 2 | 1 to 65535<br>Specifies the numerator of the dividing ratio for FA and FB pulse output. | N | 1000 | Y | Y | 0 | Y | Y | N | Y | |
| E110 | 1E0Ah | h | (Denominator) | 1 | 1 to 65535<br>Specifies the denominator of the dividing ratio for FA and FB pulse output. | N | 1000 | Y | Y | 0 | Y | Y | N | Y | |
| E114 | 1E0Eh | h | Speed Agreement 2 (Detection width) | 4 | 1.0 to 20.0%<br>If ***N-FB2±*** (Detected speed 2) is within the range of ***N-REF4*** (Reference speed 4) ± this detection width, the inverter issues the speed agreement signal ***N-AG2***. | Y | 3.0 | Y | Y | 2 | Y | Y | N | Y | |
| E115 | 1E0Fh | h | (Off-delay timer) | 1 | 0.000 to 5.000 s<br>Specifies the off-delay timer of the speed agreement signal ***N-AG2***. | Y | 0.100 | Y | Y | 4 | Y | Y | N | Y | |
| E116 | 1E10h | h | Speed Agreement 3 (Detection width) | 1 | 1.0 to 20.0%<br>If ***N-FB2±*** (Detected speed 2) is within the range of ***N-REF4*** (Reference speed 4) ± this detection width, the inverter issues the speed agreement signal ***N-AG3***. | Y | 3.0 | Y | Y | 2 | Y | Y | N | Y | |
| E117 | 1E11h | h | (Off-delay timer) | 1 | 0.000 to 5.000 s<br>Specifies the off-delay timer of the speed agreement signal ***N-AG3***. | Y | 0.100 | Y | Y | 4 | Y | Y | N | Y | |
| E118 | 1E12h | h | Electric Motor Fan Stop Signal Preset Temperature | 0 | 0 to 200<br>If the NTC detection temperature of the motor fan having an NTC thermistor drops below this setting, the inverter turns ON the axial fan stopped signal ***MFAN***. | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |

### 5.3.3 C codes (Control Functions)

| Function code | Communications address 485 No. | Communications address Link No. | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control: VC w/ PG | Drive control: VC w/o PG | Drive control: V/f | Drive control: VC for PMSM | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C01 | 201h | h | Jump Speed 1 | 4 | 0 to 30000 r/min<br>Enables the inverter to jump over a point on the reference speed in order to skip a resonance point of the driven machinery (load) and the motor speed.<br>Up to three different jump points can be specified. | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| C02 | 202h | h | Jump Speed 2 | 1 | 0 to 30000 r/min | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| C03 | 203h | h | Jump Speed 3 | 1 | 0 to 30000 r/min | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| C04 | 204h | h | Hysteresis Width for Jump Speed | 1 | 0 to 1000 r/min | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| C05 | 205h | 9Eh | Multistep Speed 1 | 17 | 0 to 30000 r/min / 0.00 to 100.00% /<br>0.0 to 999.9 m/min (Switchable by C21)<br>Multistep speeds 1 to 15 can be switched by turning terminal commands ***SS1***, ***SS2***, ***SS4*** and ***SS8*** ON/OFF. | Y | 0/0.00/<br>0.0 | Y | Y | 0 | Y | Y | Y | Y | |
| C06 | 206h | 9Fh | Multistep Speed 2 | 1 | 0 to 30000 r/min / 0.00 to 100.00% /<br>0.0 to 999.9 m/min (Switchable by C21) | Y | 0/0.00/<br>0.0 | Y | Y | 0 | Y | Y | Y | Y | |
| C07 | 207h | A0h | Multistep Speed 3 | 1 | 0 to 30000 r/min / 0.00 to 100.00% /<br>0.0 to 999.9 m/min (Switchable by C21) | Y | 0/0.00/<br>0.0 | Y | Y | 0 | Y | Y | Y | Y | |
| C08 | 208h | A1h | Multistep Speed 4 | 1 | 0 to 30000 r/min / 0.00 to 100.00% /<br>0.0 to 999.9 m/min (Switchable by C21) | Y | 0/0.00/<br>0.0 | Y | Y | 0 | Y | Y | Y | Y | |
| C09 | 209h | A2h | Multistep Speed 5 | 1 | 0 to 30000 r/min / 0.00 to 100.00% /<br>0.0 to 999.9 m/min (Switchable by C21) | Y | 0/0.00/<br>0.0 | Y | Y | 0 | Y | Y | Y | Y | |
| C10 | 20Ah | A3h | Multistep Speed 6 | 1 | 0 to 30000 r/min / 0.00 to 100.00% /<br>0.0 to 999.9 m/min (Switchable by C21) | Y | 0/0.00/<br>0.0 | Y | Y | 0 | Y | Y | Y | Y | |
| C11 | 20Bh | A4h | Multistep Speed 7 | 1 | 0 to 30000 r/min / 0.00 to 100.00% /<br>0.0 to 999.9 m/min (Switchable by C21) | Y | 0/0.00/<br>0.0 | Y | Y | 0 | Y | Y | Y | Y | |
| C12 | 20Ch | h | Multistep Speed 8 | 1 | 0 to 30000 r/min / 0.00 to 100.00% /<br>0.0 to 999.9 m/min (Switchable by C21) | Y | 0/0.00/<br>0.0 | Y | Y | 0 | Y | Y | Y | Y | |
| C13 | 20Dh | h | Multistep Speed 9 | 1 | 0 to 30000 r/min / 0.00 to 100.00% /<br>0.0 to 999.9 m/min (Switchable by C21) | Y | 0/0.00/<br>0.0 | Y | Y | 0 | Y | Y | Y | Y | |
| C14 | 20Eh | h | Multistep Speed 10 | 1 | 0 to 30000 r/min / 0.00 to 100.00% /<br>0.0 to 999.9 m/min (Switchable by C21) | Y | 0/0.00/<br>0.0 | Y | Y | 0 | Y | Y | Y | Y | |
| C15 | 20Fh | h | Multistep Speed 11 | 1 | 0 to 30000 r/min / 0.00 to 100.00% /<br>0.0 to 999.9 m/min (Switchable by C21) | Y | 0/0.00/<br>0.0 | Y | Y | 0 | Y | Y | Y | Y | |
| C16 | 210h | h | Multistep Speed 12 | 1 | 0 to 30000 r/min / 0.00 to 100.00% /<br>0.0 to 999.9 m/min (Switchable by C21) | Y | 0/0.00/<br>0.0 | Y | Y | 0 | Y | Y | Y | Y | |
| C17 | 211h | h | Multistep Speed 13 | 1 | 0 to 30000 r/min / 0.00 to 100.00% /<br>0.0 to 999.9 m/min (Switchable by C21) | Y | 0/0.00/<br>0.0 | Y | Y | 0 | Y | Y | Y | Y | |
| C18 | 212h | h | Multistep Speed 14/<br>Creeping Speed 1 | 1 | 0 to 30000 r/min / 0.00 to 100.00% /<br>0.0 to 999.9 m/min (Switchable by C21)<br>C18 and C19 apply also to the creep speed under UP/DOWN control. | Y | 0/0.00/<br>0.0 | Y | Y | 0 | Y | Y | Y | Y | |
| C19 | 213h | h | Multistep Speed 15/<br>Creeping Speed 2 | 1 | 0 to 30000 r/min / 0.00 to 100.00% /<br>0.0 to 999.9 m/min (Switchable by C21) | Y | 0/0.00/<br>0.0 | Y | Y | 0 | Y | Y | Y | Y | |
| C20 | 214h | h | Multistep Speed Agreement Timer | 1 | 0.000 to 0.100 s<br>When ***SS1***, ***SS2***, ***SS4*** and ***SS8*** are kept at the same status for the duration specified by this function code, the inverter switches the reference speed. | Y | 0.000 | Y | Y | 4 | Y | Y | Y | Y | |
| C21 | 215h | h | Multistep Speed Configuration Definition | 1 | 0 to 2<br>0: 0 to 30000 r/min<br>1: 0.00 to 100.00%<br>2: 0.0 to 999.9 m/min<br>Defines the unit of multistep speed specified by C05 to C19. When C21 = 1, the percentage of the maximum speed (F03/A06/A106) of the selected motor applies. | N | 0 | Y | Y | 93 | Y | Y | Y | Y | |
| C25 | 219h | h | Speed Command N2 | 0 | 0 to 9<br>0: Keypad (⌃/⌄ keys)<br>1: Analog input to terminal [12](0 to ±10V)<br>2: Analog input to terminal [12](0 to +10V)<br>3: ***UP/DOWN*** control (Initial speed = 0)<br>4: ***UP/DOWN*** control (Initial speed = Last value)<br>5: ***UP/DOWN*** control (Initial speed = Creep speed 1 or 2)<br>6: DIA card input<br>7: DIB card input<br>8: N-REFV input to terminal [Ai1]<br>9: N-REFC input to terminal [Ai2]<br>The speed command specified by this function code takes effect when X terminal command ***N2/N1*** is turned ON. | N | 0 | Y | Y | 41 | Y | Y | Y | Y | |
| C29 | 21Dh | h | Jogging Speed | 0 | 0 to 30000 r/min<br>Specifies the speed to be applied when the motor jogs. | Y | 50 | Y | Y | 0 | Y | Y | Y | Y | |
| C30 | 21Eh | h | ASR-JOG (P-gain) | 9 | 0.1 to 500.0 times | Y | 10.0 | Y | Y | 2 | Y | Y | N | Y | |
| C31 | 21Fh | h | (I-constant) | 1 | 0.000 to 10.000 s<br>P control when C31 = 0.000 | Y | 0.200 | Y | Y | 4 | Y | Y | N | Y | |

| Function code | Communications address | | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 485 No. | Link No. | | | | | | | | | VC w/ PG | VC w/o PG | V/f | VC for PMSM | |
| C32 | 220h | h | (Input filter) | 1 | 0.000 to 5.000 s | Y | 0.040 | Y | Y | 4 | Y | Y | Y | Y | |
| C33 | 221h | h | (Detection filter) | 1 | 0.000 to 0.100 s | Y | 0.005 | Y | Y | 4 | Y | Y | N | Y | |
| C34 | 222h | h | (Output filter) | 1 | 0.000 to 0.100 s | N | 0.002 | Y | Y | 4 | Y | Y | N | Y | |
| C35 | 223h | h | Acceleration Time for Jogging | 1 | 0.01 to 99.99 s<br>100.0 to 999.9 s<br>1000 to 3600 s | Y | 5.00 | Y | Y | 13 | Y | Y | Y | Y | |
| C36 | 224h | h | Deceleration Time for Jogging | 1 | 0.01 to 99.99 s<br>100.0 to 999.9 s<br>1000 to 3600 s | Y | 5.00 | Y | Y | 13 | Y | Y | Y | Y | |
| C37 | 225h | h | S-curve JOG (Start side) | 1 | 0 to 50% | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| C38 | 226h | h | S-curve JOG (End side) | 1 | 0 to 50% | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| C40 | 228h | h | ASR2 (P-gain) | 10 | 0.1 to 500.0 times | Y | 10.0 | Y | Y | 2 | Y | Y | N | Y | |
| C41 | 229h | h | (I-constant) | 1 | 0.000 to 10.000 s<br>P control when C41 = 0.000 | Y | 0.200 | Y | Y | 4 | Y | Y | N | Y | |
| C42 | 22Ah | h | (Feedforward gain) | 1 | 0.000 to 9.999 s | Y | 0.000 | Y | Y | 4 | Y | Y | N | Y | |
| C43 | 22Bh | h | (Input filter) | 1 | 0.000 to 5.000 s | Y | 0.040 | Y | Y | 4 | Y | Y | Y | Y | |
| C44 | 22Ch | h | (Detection filter) | 1 | 0.000 to 0.100 s | Y | 0.005 | Y | Y | 4 | Y | Y | N | Y | |
| C45 | 22Dh | h | (Output filter) | 1 | 0.000 to 0.100 s | N | 0.002 | Y | Y | 4 | Y | Y | N | Y | |
| C46 | 22Eh | h | Acceleration Time 2 | 1 | 0.01 to 99.99 s<br>100.0 to 999.9 s<br>1000 to 3600 s | Y | 5.00 | Y | Y | 13 | Y | Y | Y | Y | |
| C47 | 22Fh | h | Deceleration Time 2 | 1 | 0.01 to 99.99 s<br>100.0 to 999.9 s<br>1000 to 3600 s | Y | 5.00 | Y | Y | 13 | Y | Y | Y | Y | |
| C48 | 230h | h | S-curve 2 (Start side) | 1 | 0 to 50% | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| C49 | 231h | h | S-curve 2 (End side) | 1 | 0 to 50% | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| C50 | 232h | h | ASR3 (P-gain) | 10 | 0.1 to 500.0 times | Y | 10.0 | Y | Y | 2 | Y | Y | N | Y | |
| C51 | 233h | h | (I-constant) | 1 | 0.000 to 10.000 s<br>P control when C41 = 0.000 | Y | 0.200 | Y | Y | 4 | Y | Y | N | Y | |
| C52 | 234h | h | (Feedforward gain) | 1 | 0.000 to 9.999 s | Y | 0.000 | Y | Y | 4 | Y | Y | N | Y | |
| C53 | 235h | h | (Input filter) | 1 | 0.000 to 5.000 s | Y | 0.040 | Y | Y | 4 | Y | Y | Y | Y | |
| C54 | 236h | h | (Detection filter) | 1 | 0.000 to 0.100 s | Y | 0.005 | Y | Y | 4 | Y | Y | N | Y | |
| C55 | 237h | h | (Output filter) | 1 | 0.000 to 0.100 s | N | 0.002 | Y | Y | 4 | Y | Y | N | Y | |
| C56 | 238h | h | Acceleration Time 3 | 1 | 0.01 to 99.99 s<br>100.0 to 999.9 s<br>1000 to 3600 s | Y | 5.00 | Y | Y | 13 | Y | Y | Y | Y | |
| C57 | 239h | h | Deceleration Time 3 | 1 | 0.01 to 99.99 s<br>100.0 to 999.9 s<br>1000 to 3600 s | Y | 5.00 | Y | Y | 13 | Y | Y | Y | Y | |
| C58 | 23Ah | h | S-curve 3 (Start side) | 1 | 0 to 50% | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| C59 | 23Bh | h | S-curve 3 (End side) | 1 | 0 to 50% | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| C60 | 23Ch | h | ASR4 (P-gain) | 10 | 0.1 to 500.0 times | Y | 10.0 | Y | Y | 2 | Y | Y | N | Y | |
| C61 | 23Dh | h | (I-gain) | 1 | 0.000 to 10.000 s<br>P control when C41 = 0.000 | Y | 0.200 | Y | Y | 4 | Y | Y | N | Y | |
| C62 | 23Eh | h | (Feedforward gain) | 1 | 0.000 to 9.999 s | Y | 0.000 | Y | Y | 4 | Y | Y | N | Y | |
| C63 | 23Fh | h | (Input filter) | 1 | 0.000 to 5.000 s | Y | 0.040 | Y | Y | 4 | Y | Y | Y | Y | |
| C64 | 240h | h | (Detection filter) | 1 | 0.000 to 0.100 s | Y | 0.005 | Y | Y | 4 | Y | Y | N | Y | |
| C65 | 241h | h | (Output filter) | 1 | 0.000 to 0.100 s | N | 0.002 | Y | Y | 4 | Y | Y | N | Y | |
| C66 | 242h | h | Acceleration Time 4 | 1 | 0.01 to 99.99 s<br>100.0 to 999.9 s<br>1000 to 3600 s | Y | 5.00 | Y | Y | 13 | Y | Y | Y | Y | |
| C67 | 243h | h | Deceleration Time 4 | 1 | 0.01 to 99.99 s<br>100.0 to 999.9 s<br>1000 to 3600 s | Y | 5.00 | Y | Y | 13 | Y | Y | Y | Y | |
| C68 | 244h | h | S-curve 4 (Start side) | 1 | 0 to 50% | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| C69 | 245h | h | S-curve 4 (End side) | 1 | 0 to 50% | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| C70 | 246h | h | ASR Switching Time | 0 | 0.00 to 2.55 s | Y | 1.00 | Y | Y | 3 | Y | Y | N | Y | |
| C71 | 247h | A5h | ACC/DEC Switching Speed | 0 | 0.00 to 100.00% | Y | 0.00 | Y | Y | 3 | Y | Y | Y | Y | |
| C72 | 248h | A6h | ASR Switching Time | 0 | 0.00 to 100.00% | Y | 0.00 | Y | Y | 3 | Y | Y | N | Y | |
| C73 | 249h | h | Creep Speed Switching (under UP/DOWN control) | 0 | 00 to 11<br>(Creep Speed 1)(Creep Speed 2)<br>0: Function code setting (C18, C19)<br>1: Analog input (***CRP1***, ***CRP2***) | N | 00 | Y | Y | 9 | Y | Y | Y | Y | |

### 5.3.4 P codes (Motor Parameter Functions M1)

| Function code | Communications address: 485 No. | Communications address: Link No. | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control: VC w/ PG | Drive control: VC w/o PG | Drive control: V/f | Drive control: VC for PMSM | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P01 | 301h | h | M1 Drive Control | 0 | 0 to 5<br>0: Vector control for IM with speed sensor<br>1: Vector control for IM without speed sensor<br>2: Simulation mode<br>3: Vector control for PMSM with speed sensor<br>4: --<br>5: V/f control for IM | N | 0 | Y | N | 55 | Y | Y | Y | Y | |
| P02 | 302h | h | M1 Motor Selection | 26 | 0 to 50<br>Display (kW, HP) changes by setting F60.<br>0 to 35: Settings for VG-dedicated motors<br>Data at F04, F05, and P03 to P27 are automatically set and write-protected.<br>36: P-OTHER (P-OTR on the keypad)<br>Data at F04, F05, and P03 to P27 are write-protected and cannot be overwritten.<br>37: OTHER<br>Data at F04, F05, and P03 to P27 are write-protected and cannot be overwritten.<br>38 to 50: Settings for the motor only for FRENIC-VG (8-series)<br>Data at F04, F05, and P03 to P27 are automatically set and write-protected.<br>For the relationship between the setting data and the motor type, refer to "List of Applicable Motors" in Section 5.3.4, P02 codes. | N | * | Y | N | 82 | Y | Y | Y | Y | |
| P03 | 303h | A7h | M1 Rated Capacity | 1 | For inverters of 400 kW or below<br>0.00 to 500.00 kW when F60 = 0<br>0.00 to 600.00 HP when F60 = 1<br>For inverters of 500 kW or above<br>0.00 to 1200 kW when F60 = 0<br>0.00 to 1600 HP when F60 = 1<br>For multiwinding motors, set the motor capacity per wiring. | N | * | Y | N | 3<br>13 | Y | Y | Y | Y | |
| P04 | 304h | A8h | M1 Rated Current | 1 | 0.01 to 99.99 A<br>100.0 to 999.9 A<br>1000 to 2000 A | N | * | Y | N | 13 | Y | Y | Y | Y | |
| P05 | 305h | A9h | M1 Number of Poles | 1 | 2 to 100 poles | N | 4 | Y | N | 1 | Y | Y | Y | Y | |
| P06 | 306h | AAh | M1 %R1 | 1 | 0.00 to 30.00% | Y | * | Y | N | 3 | Y | Y | Y | Y | |
| P07 | 307h | ABh | M1 %X | 1 | 0.00 to 200.00% | Y | * | Y | N | 3 | Y | Y | Y | Y | |
| P08 | 308h | ACh | M1 Exciting Current/Magnetic Flux Weakening Current (-Id) | 1 | 0.01 to 99.99 A<br>100.0 to 999.9 A<br>1000 to 2000 A | Y | * | Y | N | 13 | Y | Y | Y | Y | |
| P09 | 309h | ADh | M1 Torque Current | 1 | 0.01 to 99.99 A<br>100.0 to 999.9 A<br>1000 to 2000 A | Y | * | Y | N | 13 | Y | Y | N | Y | |
| P10 | 30Ah | AEh | M1 Slip Frequency (For driving) | 1 | 0.001 to 10.000 Hz | Y | * | Y | N | 4 | Y | Y | N | N | |
| P11 | 30Bh | AFh | (For braking) | 1 | 0.001 to 10.000 Hz | Y | * | Y | N | 4 | Y | Y | N | N | |
| P12 | 30Ch | B0h | M1 Iron Loss Factor 1 | 1 | 0.00 to 10.00% | Y | * | Y | N | 3 | Y | Y | N | Y | |
| P13 | 30Dh | B1h | M1 Iron Loss Factor 2 | 1 | 0.00 to 10.00% | Y | * | Y | N | 3 | Y | Y | N | Y | |
| P14 | 30Eh | B2h | M1 Iron Loss Factor 3 | 1 | 0.00 to 10.00% | Y | * | Y | N | 3 | Y | Y | N | Y | |
| P15 | 30Fh | B3h | M1 Magnetic Saturation Factor 1 | 1 | 0.0 to 100.0%<br>Compensation factor for exciting current when the magnetic flux command is 93.75% | Y | * | Y | N | 2 | Y | Y | N | N | |
| P16 | 310h | B4h | M1 Magnetic Saturation Factor 2 | 1 | 0.0 to 100.0%<br>Compensation factor for exciting current when the magnetic flux command is 87.5% | Y | * | Y | N | 2 | Y | Y | N | N | |
| P17 | 311h | B5h | M1 Magnetic Saturation Factor 3 | 1 | 0.0 to 100.0%<br>Compensation factor for exciting current when the magnetic flux command is 75% | Y | * | Y | N | 2 | Y | Y | N | N | |
| P18 | 312h | B6h | M1 Magnetic Saturation Factor 4 | 1 | 0.0 to 100.0%<br>Compensation factor for exciting current when the magnetic flux command is 62.5% | Y | * | Y | N | 2 | Y | Y | N | N | |
| P19 | 313h | B7h | M1 Magnetic Saturation Factor 5 | 1 | 0.0 to 100.0%<br>Compensation factor for exciting current when the magnetic flux command is 50% | Y | * | Y | N | 2 | Y | Y | N | N | |
| P20 | 314h | B8h | M1 Secondary Time Constant | 1 | 0.001 to 9.999 s | Y | * | Y | N | 4 | Y | Y | N | N | |
| P21 | 315h | B9h | M1 Induced Voltage Factor | 1 | 0 to 999 V | Y | * | Y | N | 0 | Y | Y | N | Y | |
| P22 | 316h | BAh | M1 R2 Correction Factor 1 | 1 | 0.500 to 5.000 | Y | * | Y | N | 4 | Y | Y | N | Y | |
| P23 | 317h | BBh | M1 R2 Correction Factor 2 | 1 | 0.500 to 5.000 | Y | * | Y | N | 4 | Y | Y | N | N | |
| P24 | 318h | BCh | M1 R2 Correction Factor 3 | 1 | 0.010 to 5.000 | Y | * | Y | N | 4 | Y | Y | N | N | |
| P25 | 319h | BDh | M1 Exciting Current Correction Factor | 1 | 0.000 to 5.000 | Y | * | Y | N | 4 | Y | Y | N | N | |
| P26 | 31Ah | BEh | M1 ACR (P-gain) | 1 | 0.1 to 20.0 | Y | 1.0 | Y | N | 2 | Y | Y | N | Y | |
| P27 | 31Bh | BFh | (I-time) | 1 | 0.1 to 100.0 ms | Y | 1.0 | Y | N | 2 | Y | Y | N | Y | |

*Depending upon the inverter's capacity.

| Function code | Communications address | | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 485 No. | Link No. | | | | | | | | | VC w/ PG | VC w/o PG | V/f | VC for PMSM | |
| P28 | 31Ch | C0h | M1 Pulse Resolution | 0 | 100 to 60000 | N | 1024 | Y | N | 0 | Y | N | N | Y | |
| P29 | 31Dh | D6h | M1 External PG Correction Factor | 0 | 0000 to 4FFF | N | 4000 | Y | N | 9 | Y | N | N | N | |
| P30 | 31Eh | C1h | M1 Thermistor Selection | 0 | 0 to 3<br>0: No thermistor<br>1: NTC thermistor<br>2: PTC thermistor<br>3: Ai (***M-TMP***)<br>The protection level of the motor protective functions should be specified by E30 to E32. | N | 1 | Y | N | 84 | Y | Y | Y | Y | |
| P32 | 320h | h | M1 Online Auto-tuning | 0 | 0 or 1<br>0: Disable<br>1: Enable<br>Enabling this auto-tuning activates the compensation function for the resistance change caused by the temperature rise of the motor running. | Y | 0 | Y | N | 0 | Y | Y | N | N | |
| P33 | 321h | h | M1 Maximum Output Voltage/ Maximum Voltage Limit | 0 | 80 to 999 V | Y | 220/ 440 | Y | N | 0 | N | N | Y | Y | |
| P34 | 322h | h | M1 Slip Compensation | 3 | -20.000 to 5.000 Hz | Y | 0.000 | Y | N | 8 | N | N | Y | N | |
| P35 | 323h | h | M1 Torque Boost | 1 | 0.0 to 20.0<br>Exclusive to V/f control.<br>0.0: Auto torque boost (for constant torque load)<br>0.1 to 0.9: For variable torque load<br>1.0 to 1.9: For proportional torque load<br>2.0 to 20.0: For constant torque load | Y | 0.0 | Y | N | 2 | N | N | Y | N | |
| P36 | 324h | h | M1 Output Current Fluctuation Damping Gain | 1 | 0.00 to 1.00 | Y | 0.20 | Y | N | 3 | N | N | Y | N | |
| P42 | 32Ah | h | M1 q-axis Inductance Magnetic Saturation Coefficient | 9 | 0 to 100% | Y | 100.0 | Y | N | 0 | N | N | N | Y | |
| P43 | 32Bh | h | M1 Magnetic Flux Limiting Value | 1 | 50.0 to 150.0% | Y | * | Y | N | 2 | N | N | N | Y | |
| P44 | 32Ch | h | M1 Overcurrent Protection Level | 1 | 0.00: Disable<br>0.01 to 2000 A<br>Specifies the allowable current value to prevent the permanent magnet of a PMSM from getting demagnetized. If the current exceeding this setting flows, an overcurrent alarm (OC) occurs. | N | 0.00 | Y | N | 0 | N | N | N | Y | |
| P45 | 32Dh | h | M1 Torque Correction Gain 1 | 1 | 0.00 to 10.00 | Y | * | Y | N | 3 | N | N | N | Y | |
| P46 | 32Eh | h | M1 Torque Correction Gain 2 | 1 | 0.00 to 10.00 | Y | * | Y | N | 3 | N | N | N | Y | |
| P47 | 32Fh | h | M1 Torque Correction Gain 3 | 1 | -1.000 to 1.000 | Y | * | Y | N | 8 | N | N | N | Y | |
| P48 | 330h | h | M1 Torque Correction Gain 4 | 1 | -1.000 to 1.000 | Y | * | Y | N | 8 | N | N | N | Y | |
| P49 | 331h | h | M1 Torque Correction Gain 5 | 1 | -50.00 to 50.00 | Y | * | Y | N | 7 | N | N | N | Y | |
| P50 | 332h | h | M1 Torque Correction Gain 6 | 1 | -50.00 to 50.00 | Y | * | Y | N | 7 | N | N | N | Y | |
| P51 | 333h | h | M1 Torque Correction Gain 7 | 1 | -1.000 to 1.000 | Y | * | Y | N | 8 | N | N | N | Y | |

*Depending upon the inverter's capacity.

### 5.3.5 H codes (High Performance Functions)

| Function code | Communications address 485 No. | Communications address Link No. | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control: VC w/ PG | Drive control: VC w/o PG | Drive control: V/f | Drive control: VC for PMSM | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H01 | 401h | h | Auto-tuning | 0 | 0 to 4<br>0: Disable | N | 0 | N | N | 61 | Y | Y | Y | Y | |
| | | | | | 1: ASR auto-tuning (Available soon) | | | | | | Y | Y | N | Y | |
| | | | | | 2: Motor parameter auto-tuning (R1, Lσ) | | | | | | Y | Y | Y | N | |
| | | | | | 3: Auto-tuning with the motor stopped | | | | | | Y | Y | N | N | |
| | | | | | 4: Auto-tuning with the motor running | | | | | | Y | Y | N | N | |
| | | | | | Upon completion of auto-tuning, the H01 data automatically reverts to "0."<br>To save the tuned data, perform the Full save function (H02). | | | | | | | | | | |
| H02 | 402h | Eh | Full Save Function | 0 | 0 or 1<br>When tuning is executed at H01 and the internal data is written, or when the data is written by way of the link system (T-Link, field bus, and RS-458, etc.), the data goes out when the power supply of the inverter is turned off. This function must operate when preservation is necessary. After writing the data, this function's data code automatically returns to 0. | Y | 0 | N | N | 11 | Y | Y | Y | Y | |
| H03 | 403h | h | Data Initialization | 0 | 0 or 1<br>Setting H03 to "1" reverts the function code data modified by the customer to the factory defaults. Initialization targets include all fields of F, E, C, H, o, L and U codes except motor parameter fields (P, A) and F04, F05, F10 to F12., F58<br>Upon completion of the initialization, the H03 data automatically reverts to "0." | N | 0 | N | N | 11 | Y | Y | Y | Y | |
| H04 | 404h | h | Auto-reset (Times) | 0 | 0 to 10<br>0: Disable<br>1 to 10 times<br>The auto-resetting signal can be output to the output terminal. | N | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| H05 | 405h | H | Auto-reset (Reset interval) | 0 | 0.01 to 20.00 s | N | 5.00 | Y | Y | 3 | Y | Y | Y | Y | |
| H06 | 406h | h | Cooling Fan ON/OFF Control | 0 | 0 or 1<br>0: Disable<br>1: Enable<br>This control detects the temperature of the heat sink in the inverter unit and turns the cooling fan ON/OFF automatically.<br>It is possible to output the ***FAN*** (Cooling fan in operation) signal in conjunction with this function. | N | 0 | Y | Y | 68 | Y | Y | Y | Y | |
| H08 | 408h | h | Rev. Phase Sequence Lock | 0 | 0 or 1<br>0: Disable<br>1: Enable | Y | 0 | Y | Y | 68 | Y | N | N | Y | |
| H09 | 409h | C2h | Starting Mode (Auto search) | 0 | 0 to 2<br>0: Disable<br>1: Enable (At restart after momentary power failure)<br>2: Enable<br>Auto search detects the idling motor speed at starting and drives the motor at the same speed without stopping it. | Y | 2 | Y | Y | 0 | Y | Y | N | Y | |
| H10 | 40Ah | C3h | Energy-saving Operation | 0 | 0 or 1<br>0: Disable<br>1: Enable | N | 0 | Y | Y | 68 | Y | N | N | N | |
| H11 | 40Bh | h | Automatic Operation OFF Function | 0 | 0 to 4<br>0: Decelerate to stop when FWD-CM or REV-CM is opened<br>1: The inverter is turned off below the stop speed even for ON between FWD-CM and REV-CM.<br>2: Coast to stop when FWD-CM or REV-CM is opened<br>3: Decelerate to stop using ASR when FWD-CM or REV-CM is opened (under torque control)<br>4: Coast to stop when FWD-CM or REV-CM is opened (under torque control) | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| H13 | 40Dh | C4h | Restart Mode after Momentary Power Failure (Wait time) | 5 | 0.1 to 5.0 s | N | 0.5 | Y | Y | 2 | Y | Y | Y | Y | |
| H14 | 40Eh | h | (Decrease rate in speed) | 1 | 1 to 3600 r/min/s | Y | 500 | Y | Y | 0 | N | N | Y | N | |
| H15 | 40Fh | h | (Continuous running level) | 1 | 3-phase 200 V: 200 to 300 V<br>3-phase 400 V: 400 to 600 V<br>This setting applies when F14 = 2 (Trip after recovery from power failure) or F14 = 3 (Continue to run). | Y | 235/ 470 | Y | Y | 0 | Y | Y | Y | Y | |
| H16 | 410h | h | (Run command self-hold setting) | 1 | 0 or 1<br>0: Setting made by H17<br>1: Maximum time (The inverter self-holds the run command while the control power supply in the inverter is established or until the DC link bus voltage comes to almost "0.") | N | 1 | Y | Y | 94 | Y | Y | Y | Y | |

| Function code | Communications address: 485 No. | Communications address: Link No. | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control: VC w/ PG | Drive control: VC w/o PG | Drive control: V/f | Drive control: VC for PMSM | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H17 | 411h | h | (Run command self-hold time) | 1 | 0.0 to 30.0 s | N | 30.0 | Y | Y | 2 | Y | Y | Y | Y | |
| H19 | 413h | C5h | Active Drive | 0 | 0 or 1<br>0: Disable<br>1: Enable<br>Under vector control, this function automatically limits the output torque to avoid an overload trip, etc. | N | 0 | Y | Y | 68 | Y | N | Y | Y | |
| H20 | 414h | C6h | PID Control (Mode selection) | 8 | 0 to 3<br>0: Inactive<br>1: Active<br>2: Inverse action 1<br>3: Inverse action 2 | N | 0 | Y | Y | 69 | Y | Y | Y | Y | |
| H21 | 415h | C7h | (Command selection) | 1 | 0 or 1<br>0: Keypad or input to terminal [12]<br>1: Analog input ***PID-REF*** | Y | 0 | Y | Y | 70 | Y | Y | Y | Y | |
| H22 | 416h | C9h | (P-action) | 1 | 0.000 to 10.000 times | Y | 1.000 | Y | Y | 4 | Y | Y | Y | Y | |
| H23 | 417h | CAh | (I-action) | 1 | 0.00 to 100.00 s | Y | 1.00 | Y | Y | 3 | Y | Y | Y | Y | |
| H24 | 418h | CBh | (D-action) | 1 | 0.000 to 10.000 s | Y | 0.000 | Y | Y | 4 | Y | Y | Y | Y | |
| H25 | 419h | C8h | (Upper limit) | 1 | -300 to 300% | N | 100 | Y | Y | 5 | Y | Y | Y | Y | |
| H26 | 41Ah | CCh | (Lower limit) | 1 | -300 to 300% | N | -100 | Y | Y | 5 | Y | Y | Y | Y | |
| H27 | 41Bh | CEh | (Speed command selection) | 1 | 0 to 2<br>0: Disable<br>1: Select PID<br>2: Select auxiliary speed | N | 0 | Y | Y | 95 | Y | Y | Y | Y | |
| H28 | 41Ch | CFh | Droop Control | 0 | 0.0 to 25.0% | Y | 0.0 | Y | Y | 2 | Y | Y | N | Y | |
| H29 | 41Dh | h | Communications Link Function (Data protection via link) | 2 | 0 or 1<br>0: Writable to function code fields<br>1: Write-protect function code fields<br>Setting H29 to "1" protects function code data from getting changed mistakenly via the link (T-Link, RS-485, etc.).<br>Via the link, data can be written to the "function code fields" (given above) or "command data fields" (S fields). The S fields are defined by H30. | Y | 0 | Y | Y | 40 | Y | Y | Y | Y | |
| H30 | 41Eh | D0h | (Link operation) | 1 | 0 to 3<br>Monitor / Command data / Run command (FWD, REV)<br>0: Y / N / N<br>1: Y / Y / N<br>2: Y / N / Y<br>3: Y / Y / Y | Y | 0 | Y | Y | 72 | Y | Y | Y | Y | |
| H31 | 41Fh | h | RS-485 Communication (Station address) | 10 | 0 to 255<br>Broadcast: (0: RTU), (99: Fuji)<br>Address: 1 to 255<br>Specify the station address of RS-485. | N | 1 | Y | N | 0 | Y | Y | Y | Y | |
| H32 | 420h | h | (Error processing) | 1 | 0 to 3<br>0: Immediately trip with Er5<br>1: Trip with Er5 after running for the period specified by timer H33.<br>2: Trip with Er5 if a communications error persists exceeding the period specified by timer H33.<br>3: Continue to run | Y | 3 | Y | Y | 73 | Y | Y | Y | Y | |
| H33 | 421h | h | (Timer) | 1 | 0.01 to 20.00 s | Y | 2.00 | Y | Y | 3 | Y | Y | Y | Y | |
| H34 | 422h | h | (Baud rate) | 1 | 0 to 4<br>0: 38400 bps<br>1: 19200 bps<br>2: 9600 bps<br>3: 4800 bps<br>4: 2400 bps | Y | 0 | Y | N | 74 | Y | Y | Y | Y | |
| H35 | 423h | h | (Data length) | 1 | 0 or 1<br>0: 8 bits<br>1: 7 bits | Y | 0 | Y | N | 75 | Y | Y | Y | Y | |
| H36 | 424h | h | (Parity check) | 1 | 0 to 2<br>0: None<br>1: Even parity<br>2: Odd parity | Y | 1 | Y | N | 76 | Y | Y | Y | Y | |
| H37 | 425h | h | (Stop bits) | 1 | 0 or 1<br>0: 2 bits<br>1: 1 bit | Y | 1 | Y | N | 77 | Y | Y | Y | Y | |
| H38 | 426h | h | (Communications line break time) | 1 | 0.0 to 60.0 s<br>0.0: Disable detection<br>0.1 to 60.0: Enable detection | Y | 60.0 | Y | Y | 2 | Y | Y | Y | Y | |
| H39 | 427h | h | (Response interval) | 1 | 0.00 to 1.00 s | Y | 0.01 | Y | Y | 3 | Y | Y | Y | Y | |
| H40 | 428h | h | (Protocol selection) | 1 | 0 to 2<br>0: Fuji general-purpose inverter protocol<br>1: SX protocol (Loader protocol)<br>2: Modbus RTU protocol<br>To use the FRENIC-VG Loader, set H40 to "1." | N | 1 | Y | N | 78 | Y | Y | Y | Y | |

| Function code | Communications address: 485 No. | Communications address: Link No. | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control: VC w/ PG | Drive control: VC w/o PG | Drive control: V/f | Drive control: VC for PMSM | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H41 | 429h | D1h | Torque Command Source | 4 | 0 to 5<br>0: Internal ASR output<br>1: Ai terminal input ***T-REF***<br>2: DIA card<br>3: DIB card<br>4: Communications link<br>5: PID | N | 0 | Y | Y | 64 | Y | Y | N | Y | |
| H42 | 42Ah | D2h | Torque Current Command Source | 1 | 0 to 4<br>0: Internal ASR output<br>1: Ai terminal input ***IT-REF***<br>2: DIA card<br>3: DIB card<br>4: Communications link | N | 0 | Y | Y | 65 | Y | Y | N | Y | |
| H43 | 42Bh | D3h | Magnetic Flux Command Source | 1 | 0 to 3<br>0: Internal calculation<br>1: Ai terminal input ***MF-REF***<br>2: Function code H44<br>3: Communications link | N | 0 | Y | Y | 66 | Y | N | N | N | |
| H44 | 42Ch | D4h | Magnetic Flux Command Value | 1 | 10 to 100% | N | 100 | Y | Y | 16 | Y | N | N | N | |
| H46 | 42Eh | D7h | Observer (Mode selection) | 7 | 0 to 2<br>0: Disable<br>1: Enable (Load disturbance observer)<br>2: Enable (Oscillation suppressing observer) | N | 0 | Y | Y | 79 | Y | Y | N | Y | |
| H47 | 42Fh | D8h | (M1 compensation gain) | 1 | 0.00 to 1.00 times | Y | 0.00 | Y | Y | 3 | Y | Y | N | Y | |
| H48 | 430h | h | (M2 compensation gain) | 1 | 0.00 to 1.00 times | Y | 0.00 | Y | Y | 3 | Y | Y | N | Y | |
| H49 | 431h | D9h | (M1 l-time) | 1 | 0.005 to 1.000 s | Y | 0.100 | Y | Y | 4 | Y | Y | N | Y | |
| H50 | 432h | h | (M2 l-time) | 1 | 0.005 to 1.000 s | Y | 0.100 | Y | Y | 4 | Y | Y | N | Y | |
| H51 | 433h | DAh | (M1 load inertia) | 1 | 0.001 to 50.000 kg•m$^2$<br>The magnification is switchable by H228. | Y | * | Y | N | 4 | Y | Y | N | Y | |
| H52 | 434h | h | (M2 load inertia) | 1 | 0.001 to 50.000 kg•m$^2$<br>The magnification is switchable by H228. | Y | 0.001 | Y | N | 4 | Y | Y | N | Y | |
| H53 | 435h | D5h | Line Speed Feedback Selection | 0 | 0 to 3<br>0: Disable line speed (Integrated PG enabled) Note that Ai input or PG (LD) should be high level-select in UPAC.<br>1: Detect analog line speed (AI-LINE)<br>2: Detect digital line speed (PG(LD))<br>3: High level selected signal (Select high level of motor speed and line speed.) | Y | 0 | Y | Y | 67 | Y | Y | Y | Y | |
| H55 | 437h | h | Zero Speed Control (Gain) | 2 | 0 to 100 times<br>For details, refer to X terminal command ***LOCK*** assigned by any of E01 to E13. | Y | 5 | Y | Y | 0 | Y | N | N | Y | |
| H56 | 438h | h | (Completion range) | 1 | 0 to 100 pulses | Y | 100 | Y | Y | 0 | Y | N | N | Y | |
| H57 | 439h | h | Overvoltage Suppression | 2 | 0 or 1<br>0: Disable<br>1: Enable | N | 0 | Y | Y | 68 | Y | Y | Y | Y | |
| H58 | 43Ah | h | Overcurrent Suppression | 1 | 0 or 1<br>0: Disable<br>1: Enable | N | 0 | Y | Y | 68 | Y | Y | Y | Y | |
| H60 | 43Ch | h | Load Adaptive Control (Definition 1) | 7 | 0 to 3<br>0: Disable<br>1: Method 1<br>2: Method 2<br>3: Method 3 | N | 0 | Y | Y | 80 | Y | N | N | Y | |
| H61 | 43Dh | h | (Definition 2) | 1 | 0 or 1<br>0: Winding up in forward rotation<br>1: Winding down in forward rotation | N | 0 | Y | Y | 81 | Y | N | N | Y | |
| H62 | 43Eh | h | (Winding-up speed) | 1 | 0.0 to 999.9 m/min | N | 0.0 | Y | Y | 2 | Y | N | N | Y | |
| H63 | 43Fh | h | (Counter weight) | 1 | 0.00 to 600.00 t | N | 0.00 | Y | Y | 3 | Y | N | N | Y | |
| H64 | 440h | h | (Safety coefficient) | 1 | 0.50 to 1.20 | N | 1.00 | Y | Y | 3 | Y | N | N | Y | |
| H65 | 441h | h | (Machine efficiency) | 1 | 0.500 to 1.000 | N | 0.500 | Y | Y | 4 | Y | N | N | Y | |
| H66 | 442h | h | (Rated load) | 1 | 0.00 to 600.00 t | N | 0.00 | Y | Y | 3 | Y | N | N | Y | |
| H68 | 444h | h | Alarm Data Deletion | 0 | 0 or 1<br>Setting H68 to "1" deletes all of the alarm history, alarm causes and alarm information held in the inverter memory.<br>After that, the H68 data automatically reverts to "0." | Y | 0 | N | N | 11 | Y | Y | Y | Y | |
| H70 | 446h | h | Reserved 1 | 2 | 0 to 9999<br>Reserved. (Do not access this function code.) | N | 0 | Y | N | 0 | Y | Y | N | Y | |
| H71 | 447h | h | Reserved 2 | 1 | 0 to 10<br>Reserved. (Do not access this function code.) | N | 0 | N | N | 62 | Y | Y | Y | Y | |
| H74 | 44Ah | h | PG Detection Circuit Self-diagnosis Selection | 0 | 0 or 1<br>0: Disable<br>1: Enable<br>This function performs self-diagnosis of the speed detection circuit by pulse generator signals (PA, PB). | N | 0 | Y | Y | 225 | Y | Y | N | Y | |

*Depending upon the inverter's capacity.

| Function code | Communications address: 485 No. | Communications address: Link No. | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control: VC w/ PG | Drive control: VC w/o PG | Drive control: V/f | Drive control: VC for PMSM | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H75 | 44Bh | h | Power Sequence Configuration of Main Circuit Output Wires | 0 | 0 or 1<br>0: Normal phase U-V-W<br>1: Reverse phase U-W-V<br>Using this function allows the motor to run with the phase sequence of the motor wires arbitrarily changed. | N | 0 | Y | Y | 197 | Y | Y | Y | Y | |
| H76 | 44Ch | h | Main Power Shutdown Detection | 0 | 0 or 1<br>0: Disable<br>1: Enable<br>Enable this function to enable the AC power monitor. Disable this function when DC power is supplied, e.g., connecting with a power regenerative converter. | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| H77 | 44Dh | h | Continuance Timer for Cooling Fan ON/OFF Control | 0 | 0 to 600 s<br>Specifies the condition of the cooling fan ON/OFF control by H06. | Y | 600 | Y | Y | 0 | Y | Y | Y | Y | |
| H78 | 44Eh | h | Initialization of Startup Counter/ Total Run Time | 6 | 0 to 6<br>0: Disable<br>1: M1 number of startups<br>2: M2 number of startups<br>3: M3 number of startups<br>4: M1 cumulative run time<br>5: M2 cumulative run time<br>6: M3 cumulative run time<br>Initializes the number of startups and cumulative run time. | N | 0 | N | N | 0 | Y | Y | Y | Y | |
| H79 | 44Fh | h | Initialization of Cumulative Run Time of Cooling Fan | 1 | 0 to 65535 (in units of 10 hours)<br>Initializes the cumulative run time when the cooling fan is replaced.<br>Usually, write "0" after replacement. | N | 0 | N | N | 0 | Y | Y | Y | Y | |
| H80 | 450h | h | Capacitance of DC Link Bus Capacitor | 1 | 0 to 32767<br>When the capacitance measurement is user mode (H104), setting this function code at "0" and shutting down the inverter power starts measuring the initial value of the capacitance and sets the measurement result to this function code. | N | 0 | N | N | 0 | Y | Y | Y | Y | |
| H81 | 451h | h | Initialization of Service Life of DC Link Bus Capacitor | 1 | 0 to 65535 (in units of 10 hours)<br>Initializes the elapsed time of the DC link bus capacitor. | N | 0 | N | N | 0 | Y | Y | Y | Y | |
| H82 | 452h | h | Startup Count for Maintenance | 1 | 0 to 65535<br>Specifies the number of startups for performing maintenance of the machinery. | Y | 0 | N | Y | 0 | Y | Y | Y | Y | |
| H83 | 453h | h | Maintenance Interval | 1 | 0 to 65535 (in units of 10 hours)<br>Specifies the maintenance interval for performing maintenance of the machinery. | Y | 8760 | N | Y | 0 | Y | Y | Y | Y | |
| H85 | 455h | h | Calendar Clock (Year/month) | 4 | 0000 to FFFF<br>Upper two digits: Year, Lower two digits: Month | Y | 0001 | N | Y | 143 | Y | Y | Y | Y | |
| H86 | 456h | h | (Day/hour) | 1 | 0000 to FFFF<br>Upper two digits: Date, Lower two digits: Time | Y | 0100 | N | Y | 144 | Y | Y | Y | Y | |
| H87 | 457h | h | (Minute/second) | 1 | 0000 to FFFF<br>Upper two digits: Minute, Lower two digits: Second | Y | 0000 | N | Y | 145 | Y | Y | Y | Y | |
| H88 | 458h | h | (Setting up clock) | 1 | 0 or 1<br>0: Disable<br>1: Write the current date and time<br>Setting H88 to "1" sets up the calendar clock in accordance with the settings of H85 to H87.<br>After that, the H88 data automatically reverts to "0." | Y | 0 | N | N | 11 | Y | Y | Y | Y | |
| H89 | 459h | h | Speed Detection Monitor Selection (under vector control for IM without speed sensor/under V/f control) (Available soon) | 0 | 0 or 1<br>0: Estimated value / No display<br>1: PG detected value / PG detected value | N | 0 | Y | Y | 198 | Y | Y | N | Y | |
| H90 | 45Ah | h | Overspeed Alarm Level | 0 | 100 to 160% | Y | 120 | Y | Y | 0 | Y | Y | N | Y | |
| H94 | 45Eh | h | ASR Feedforward Gain Magnification Setting (Available soon) | 0 | 0 to 2<br>0: 1 time<br>1: 10 times<br>2: 100 times<br>Switches the magnification setting of ASR1 to ASR4 feedforward gain. | Y | 0 | Y | Y | 193 | Y | Y | N | Y | |
| H99 | 463h | h | UP/DOWN S-curve Pattern (Available soon) | 0 | 0 or 1<br>0: Disable (compatible with VG7)<br>1: Enable (compatible with VG5) | N | 0 | Y | Y | 0 | Y | N | N | Y | |
| H101 | 1F01h | h | PID Command Filter Time Constant | 0 | 0 to 5000 ms<br>Specifies the time constant of the PID command filter (after switched by H21). | Y | 0 | Y | Y | 0 | Y | Y | Y | Y | |
| H102 | 1F02h | h | Magnetic Pole Position Offset Writing Permission (Available soon) | 0 | 0 or 1<br>0: Disable, 1: Enable | Y | 0 | N | Y | 68 | N | N | N | Y | |

| Function code | Communications address | | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 485 No. | Link No. | | | | | | | | | VC w/ PG | VC w/o PG | V/f | VC for PMSM | |
| H103 | 1F03h | h | Protective/Maintenance Function Selection 1 | 9 | 0000 to 1111<br>Selects the protective functions individually.<br>(0: Disable, 1: Enable)<br>Thousands digit: Start delay (LOC)<br>Hundreds digit: Ground fault (EF)<br>Tenths digit: Output phase loss (OPL)<br>Units digit: Braking transistor broken (dbA) | Y | 0101 | Y | Y | 9 | Y | Y | Y | Y | |
| H104 | 1F04h | h | Protective/Maintenance Function Selection 2 | 1 | 0000 to 1111<br>Selects the protective/maintenance functions individually.<br>(0: Disable, 1: Enable)<br>Thousands digit: PG wire break (PG)<br>Hundreds digit: Lower the carrier frequency<br>Tenths digit: Judge the life of DC link bus capacitor<br>Units digit: Select life judgment threshold of DC link bus capacitor<br>(0: Factory default level, 1: User setup level) | Y | 1110 | Y | Y | 9 | Y | Y | Y | Y | |
| H105 | 1F05h | h | Protective/Maintenance Function Selection 3 | 1 | 0000 to 1111<br>Selects the protective/maintenance functions individually.<br>(0: Disable, 1: Enable)<br>Thousands digit: --<br>Hundreds digit: --<br>Tenths digit: --<br>Units digit: -- | Y | 0000 | Y | Y | 9 | Y | Y | Y | Y | |
| H106 | 1F06h | h | Light Alarm Object Definition 1 | 1 | 0000 to 1111<br>(0: Heavy alarm (Err), 1: Light alarm (L-AL))<br>Thousands digit: OH4 "Motor overheat"<br>Hundreds digit: OL1-OL3 "Motor 1 to 3 overload"<br>Tenths digit: nrb "NTC thermistor wire break error"<br>Units digit: OH2 "External alarm" | N | 0000 | Y | Y | 9 | Y | Y | Y | Y | |
| H107 | 1F07h | h | Light Alarm Object Definition 2 | 1 | 0000 to 1111<br>(0: Heavy alarm (Err), 1: Light alarm (L-AL))<br>Thousands digit: Er5 "RS-485 communications error"<br>Hundreds digit: Er4 "Network error"<br>Tenths digit: Reserved<br>Units digit: ArF "Toggle data error" | N | 0000 | Y | Y | 9 | Y | Y | Y | Y | |
| H108 | 1F08h | h | Light Alarm Object Definition 3 | 1 | 0000 to 1111<br>(0: Heavy alarm (Err), 1: Light alarm (L-AL))<br>Thousands digit: Err "Mock alarm"<br>Hundreds digit: dFA "DC fan locked"<br>Tenths digit: Er9 "Speed mismatch"<br>LOC "Start delay"<br>Units digit: ArE "E-SX bus tact synchronization error" | N | 0000 | Y | Y | 9 | Y | Y | Y | Y | |
| H109 | 1F09h | h | Light Alarm Object Definition 4 | 1 | 0000 to 1111<br>(0: Heavy alarm (Err), 1: Light alarm (L-AL))<br>Thousands digit: Reserved<br>Hundreds digit: Reserved<br>Tenths digit: Reserved<br>Units digit: Reserved | N | 0000 | Y | Y | 9 | Y | Y | Y | Y | |
| H110 | 1F0Ah | h | Light Alarm Object Definition 5 | 1 | 0000 to 1111<br>(0: Not light alarm, 1: Light alarm (L-AL))<br>Thousands digit: MOH "Motor overheat early warning"<br>MOL "Motor overload early warning"<br>Hundreds digit: BaT "Battery life expired"<br>Tenths digit: LiF "Life time early warning"<br>Units digit: OH/OL "Heat sink overheat early warning / overload early warning" | N | 0000 | Y | Y | 9 | Y | Y | Y | Y | |
| H111 | 1F0Bh | h | Light Alarm Object Definition 6 | 1 | 0 or 1<br>0: Disable (L-AL not shown)<br>1: Enable (L-AL shown)<br>Specified whether or not to display L-AL on the LED monitor when a light alarm occurs. | N | 0 | Y | Y | 68 | Y | Y | Y | Y | |
| H112 | 1F0Ch | h | M1 Magnetic Saturation Extension Coefficient 6 | 7 | 0.0 to 100.0%<br>Compensation factor for exciting current when the magnetic flux command is 43.75%. | Y | 43.8 | Y | N | 2 | Y | N | N | N | |
| H113 | 1F0Dh | h | M1 Magnetic Saturation Extension Coefficient 7 | 1 | 0.0 to 100.0%<br>Compensation factor for exciting current when the magnetic flux command is 37.5%. | Y | 37.5 | Y | N | 2 | Y | N | N | N | |
| H114 | 1F0Eh | h | M1 Magnetic Saturation Extension Coefficient 8 | 1 | 0.0 to 100.0%<br>Compensation factor for exciting current when the magnetic flux command is 31.25%. | Y | 31.3 | Y | N | 2 | Y | N | N | N | |
| H115 | 1F0Fh | h | M1 Magnetic Saturation Extension Coefficient 9 | 1 | 0.0 to 100.0%<br>Compensation factor for exciting current when the magnetic flux command is 25%. | Y | 25.0 | Y | N | 2 | Y | N | N | N | |
| H116 | 1F10h | h | M1 Magnetic Saturation Extension Coefficient 10 | 1 | 0.0 to 100.0%<br>Compensation factor for exciting current when the magnetic flux command is 18.75%. | Y | 18.8 | Y | N | 2 | Y | N | N | N | |

| Function code | Communications address: 485 No. | Communications address: Link No. | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control: VC w/ PG | Drive control: VC w/o PG | Drive control: V/f | Drive control: VC for PMSM | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H117 | 1F11h | h | M1 Magnetic Saturation Extension Coefficient 11 | 1 | 0.0 to 100.0%<br>Compensation factor for exciting current when the magnetic flux command is 12.5%. | Y | 12.5 | Y | N | 2 | Y | N | N | N | |
| H118 | 1F12h | h | M1 Magnetic Saturation Extension Coefficient 12 | 1 | 0.0 to 100.0%<br>Compensation factor for exciting current when the magnetic flux command is 6.25%. | Y | 6.3 | Y | N | 2 | Y | N | N | N | |
| H125 | 1F19h | h | Observer (M3 compensation gain) | 1 | 0.00 to 1.00 times | Y | 0.00 | Y | Y | 3 | Y | Y | N | Y | |
| H126 | 1F1Ah | h | (M3 integral time) | 1 | 0.005 to 1.000 s | Y | 0.100 | Y | Y | 4 | Y | Y | N | Y | |
| H127 | 1F1Bh | h | (M3 load inertia) | 1 | 0.001 to 50.000 kg•m$^2$<br>The magnification is switchable by H228. | Y | 0.001 | Y | Y | 4 | Y | Y | N | Y | |
| H134 | 1F22h | h | Speed Decrease Detection Delay Timer | 5 | 0.000 to 10.000 s | N | 0.000 | Y | Y | 4 | N | Y | N | N | |
| H135 | 1F23h | h | Speed Command Detection Level (FWD) | 1 | 0.0 to 150.0 r/min | N | 0.0 | Y | Y | 2 | N | Y | N | N | |
| H136 | 1F24h | h | (REV) | 1 | 0.0 to 150.0 r/min | N | 0.0 | Y | Y | 2 | N | Y | N | N | |
| H137 | 1F25h | h | Speed Decrease Detection Level | 1 | 0.0 to 150.0 r/min | N | 0.0 | Y | Y | 2 | N | Y | N | N | |
| H138 | 1F26h | h | Speed Command Detection Delay Timer | 1 | 0.000 to 10.000 s | N | 0.000 | Y | Y | 4 | N | Y | N | N | |
| H140 | 1F28h | h | Start Delay (Detection level) | 1 | 0.0 to 300.0% | Y | 150.0 | Y | Y | 2 | Y | Y | N | Y | |
| H141 | 1F29h | h | (Detection timer) | 1 | 0.000 to 10.000 s | Y | 1.000 | Y | Y | 0 | Y | Y | N | Y | |
| H142 | 1F2Ah | h | Mock Alarm | 0 | 0 or 1<br>0: Disable<br>1: Cause a mock alarm<br>When H108 does not define a mock alarm as a light alarm, a heavy alarm (Er□□) occurs; when it defines a mock alarm as a light alarm, a light alarm (L□AL) occurs.<br>Holding down the STOP and PRG/RESET keys simultaneously for three seconds also causes a mock alarm. | Y | 0 | N | N | 11 | Y | Y | Y | Y | |
| H144 | 1F2Ch | h | Toggle Data Error Timer | 0 | 0.01 to 20.00 s<br>H144 specifies the toggle data error detection time. | Y | 0.10 | Y | Y | 3 | Y | Y | Y | Y | |
| H145 | 1F2Dh | h | Backstop for Vector Control without Speed Sensor (Lower limit frequency operation) | 4 | 0 to 3<br>0: Disable<br>1: Enable for FWD unipolar operation<br>2: Enable for REV unipolar operation<br>3: Enable for FWD/REV bipolar operation | N | 0 | Y | Y | 202 | N | Y | N | N | |
| H146 | 1F2Eh | h | (Lower limit frequency, FWD) | 1 | 0.000 to 10.000 Hz | N | 0.000 | Y | Y | 4 | N | Y | N | N | |
| H147 | 1F2Fh | h | (Lower limit frequency, REV) | 1 | 0.000 to 10.000 Hz | N | 0.000 | Y | Y | 4 | N | Y | N | N | |
| H148 | 1F30h | h | (Primary frequency estimation filter) | 0 | 0 to 100 ms<br>Increase this setting if the speed fluctuation is large under vector control without speed sensor. | N | 0 | Y | Y | 0 | N | Y | N | N | |
| H149 | 1F31h | h | Uncontrolled Machine Driving Detection Speed Setting | 0 | 0.0 to 20.0%<br>0.0: Disable<br>0.1 to 20.0%<br>Assuming the maximum speed as 100%. | N | 0.0 | Y | Y | 2 | Y | Y | N | Y | |
| H160 | 1F3Ch | h | M1 Initial Magnetic Pole Position Detection Mode (Available soon) | 3 | 0 to 3<br>0: Pull-in by current for IPMSM (Interior Permanent Magnet Synchronous Motor)<br>1: Pull-in by current for SPMSM (Surface Permanent Magnet Synchronous Motor)<br>2: Alternate system for IPMSM (Available soon)<br>3: Alternate system for IPMSM (Available soon) | N | 0 | Y | N | 0 | N | N | N | Y | |
| H161 | 1F3Dh | h | M1 Pull-in Reference Current (Available soon) | 1 | 10 to 200%<br>100%/Motor rated current | N | 80 | Y | N | 0 | N | N | N | Y | |
| H162 | 1F3Eh | h | M1 Pull-in Frequency (Available soon) | 1 | 0.1 to 10.0 Hz | N | 1.0 | Y | N | 2 | N | N | N | Y | |
| H163 | 1F3Fh | h | M1 Reference Current for Polarity Discrimination (Available soon) | 1 | 0 to 200% | N | 80 | Y | N | 0 | N | N | N | Y | |
| H164 | 1F40h | h | M1 Alternate Voltage (Available soon) | 1 | 0 to 100% | N | 0 | Y | N | 0 | N | N | N | Y | |
| H170 | 1F46h | h | M2 Initial Magnetic Pole Position Detection Mode (Available soon) | 3 | 0 to 3<br>0: Pull-in by current for IPMSM (Interior Permanent Magnet Synchronous Motor)<br>1: Pull-in by current for SPMSM (Surface Permanent Magnet Synchronous Motor)<br>2: Alternate system for IPMSM (Available soon)<br>3: Alternate system for IPMSM (Available soon) | N | 0 | Y | N | 0 | N | N | N | Y | |
| H171 | 1F47h | h | M2 Pull-in Reference Current (Available soon) | 1 | 10 to 200%<br>100%/Motor rated current | N | 80 | Y | N | 0 | N | N | N | Y | |
| H172 | 1F48h | h | M2 Pull-in Frequency (Available soon) | 1 | 0.1 to 10.0 Hz | N | 1.0 | Y | N | 2 | N | N | N | Y | |
| H173 | 1F49h | h | M2 Reference Current for Polarity Discrimination (Available soon) | 1 | 0 to 200% | N | 80 | Y | N | 0 | N | N | N | Y | |
| H174 | 1F4Ah | h | M2 Alternate Voltage (Available soon) | 1 | 0 to 100% | N | 0 | Y | N | 0 | N | N | N | Y | |
| H180 | 1F50h | h | M3 Initial Magnetic Pole Position Detection Method (Available soon) | 8 | 0 to 3<br>0: Pull-in by current for IPMSM (Interior Permanent Magnet Synchronous Motor)<br>1: Pull-in by current for SPMSM (Surface Permanent Magnet Synchronous Motor)<br>2: Alternate system for IPMSM (Available soon)<br>3: Alternate system for IPMSM (Available soon) | N | 0 | Y | N | 0 | N | N | N | Y | |

| Function code | Communications address | | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 485 No. | Link No. | | | | | | | | | VC w/ PG | VC w/o PG | V/f | VC for PMSM | |
| H181 | 1F51h | h | M3 Pull-in Reference Current (Available soon) | 1 | 10 to 200%<br>100%/Motor rated current | N | 80 | Y | N | 0 | N | N | N | Y | |
| H182 | 1F52h | h | M3 Pull-in Frequency (Available soon) | 1 | 0.1 to 10.0 Hz | N | 1.0 | Y | N | 2 | N | N | N | Y | |
| H183 | 1F53h | h | M3 Reference Current for Polarity Discrimination (Available soon) | 1 | 0 to 200% | N | 80 | Y | N | 0 | N | N | N | Y | |
| H184 | 1F54h | h | M3 Alternate Voltage (Available soon) | 1 | 0 to 100% | N | 0 | Y | N | 0 | N | N | N | Y | |
| H201 | 2001h | h | Load Adaptive Control (Load adaptive control parameter switching) (Available soon) | 13 | 0 or 1<br>0: Enable H51/H64/H65, Disable H202-H213<br>1: Disable H51/H64/H65, Enable H202-H213 | N | 0 | Y | Y | 0 | Y | N | N | Y | |
| H202 | 2002h | h | (Load inertia for winding up 1) (Available soon) | 1 | 0.001 to 50.000 kg•m$^2$<br>Applies to winding-up operation when ***AN-P2/1*** is OFF.<br>The magnification is switchable by H228. | N | 0.001 | Y | Y | 4 | Y | N | N | Y | |
| H203 | 2003h | h | (Safety coefficient for winding up 1) (Available soon) | 1 | 0.50 to 1.20<br>Applies to winding-up operation when ***AN-P2/1*** is OFF. | N | 1.00 | Y | Y | 3 | Y | N | N | Y | |
| H204 | 2004h | h | (Mechanical efficiency for winding up 1) (Available soon) | 1 | 0.500 to 1.000<br>Applies to winding-up operation when ***AN-P2/1*** is OFF. | N | 0.500 | Y | Y | 4 | Y | N | N | Y | |
| H205 | 2005h | h | (Load inertia for winding up 2) (Available soon) | 1 | 0.001 to 50.000 kg•m$^2$<br>Applies to winding-up operation when ***AN-P2/1*** is ON.<br>The magnification is switchable by H228. | N | 0.001 | Y | Y | 4 | Y | N | N | Y | |
| H206 | 2006h | h | (Safety coefficient for winding up 2) (Available soon) | 1 | 0.50 to 1.20<br>Applies to winding-up operation when ***AN-P2/1*** is ON. | N | 1.00 | Y | Y | 3 | Y | N | N | Y | |
| H207 | 2007h | h | (Mechanical efficiency for winding up 2) (Available soon) | 1 | 0.500 to 1.000<br>Applies to winding-up operation when ***AN-P2/1*** is ON. | N | 0.500 | Y | Y | 4 | Y | N | N | Y | |
| H208 | 2008h | h | (Load inertia for winding down 1) (Available soon) | 1 | 0.001 to 50.000 kg•m$^2$<br>Applies to winding-down operation when ***AN-P2/1*** is OFF.<br>The magnification is switchable by H228. | N | 0.001 | Y | Y | 4 | Y | N | N | Y | |
| H209 | 2009h | h | (Safety coefficient for winding down 1) (Available soon) | 1 | 0.50 to 1.20<br>Applies to winding-down operation when ***AN-P2/1*** is OFF. | N | 1.00 | Y | Y | 3 | Y | N | N | Y | |
| H210 | 200Ah | h | (Mechanical efficiency for winding down 1) (Available soon) | 1 | 0.500 to 1.000<br>Applies to winding-down operation when ***AN-P2/1*** is OFF. | N | 0.500 | Y | Y | 4 | Y | N | N | Y | |
| H211 | 200Bh | h | (Load inertia for winding down 2) (Available soon) | 1 | 0.001 to 50.000 kg•m$^2$<br>Applies to winding-down operation when ***AN-P2/1*** is ON.<br>The magnification is switchable by H228. | N | 0.001 | Y | Y | 4 | Y | N | N | Y | |
| H212 | 200Ch | h | (Safety coefficient for winding down 2) (Available soon) | 1 | 0.50 to 1.20<br>Applies to winding-down operation when ***AN-P2/1*** is ON. | N | 1.00 | Y | Y | 3 | Y | N | N | Y | |
| H213 | 200Dh | h | (Mechanical efficiency for winding down 2) (Available soon) | 1 | 0.500 to 1.000<br>Applies to winding-down operation when ***AN-P2/1*** is ON. | N | 0.500 | Y | Y | 4 | Y | N | N | Y | |
| H214 | 200Eh | h | (Multi-limit speed pattern function) (Available soon) | 14 | 0 or 1<br>0: Enable H60, Disable H215-H224<br>1: Disable H60, Enable H215-H224 | N | 0 | Y | Y | 0 | Y | N | N | Y | |
| H215 | 200Fh | h | (Multi-limit speed pattern at max. speed) (Available soon) | 1 | 0.1 to 100.0%<br>Specifies the torque level at the maximum speed. | N | 50.0 | Y | Y | 2 | Y | N | N | Y | |
| H216 | 2010h | h | (Multi-limit speed pattern at rated speed) (Available soon) | 1 | 0.1 to 100.0%<br>Specifies the torque level at the rated speed. | N | 100.0 | Y | Y | 2 | Y | N | N | Y | |
| H217 | 2011h | h | (Multi-limit speed pattern at rated speed x 1.1) (Available soon) | 1 | 0.1 to 100.0%<br>Specifies the torque level at the rated speed*1.1. | N | 90.9 | Y | Y | 2 | Y | N | N | Y | |
| H218 | 2012h | h | (Multi-limit speed pattern at rated speed x 1.2) (Available soon) | 1 | 0.1 to 100.0%<br>Specifies the torque level at the rated speed*1.2. | N | 83.3 | Y | Y | 2 | Y | N | N | Y | |
| H219 | 2013h | h | (Multi-limit speed pattern at rated speed x 1.4) (Available soon) | 1 | 0.1 to 100.0%<br>Specifies the torque level at the rated speed*1.4. | N | 71.4 | Y | Y | 2 | Y | N | N | Y | |
| H220 | 2014h | h | (Multi-limit speed pattern at rated speed x 1.6) (Available soon) | 1 | 0.1 to 100.0%<br>Specifies the torque level at the rated speed*1.6. | N | 62.5 | Y | Y | 2 | Y | N | N | Y | |
| H221 | 2015h | h | (Multi-limit speed pattern at rated speed x 1.8) (Available soon) | 1 | 0.1 to 100.0%<br>Specifies the torque level at the rated speed*1.8. | N | 55.5 | Y | Y | 2 | Y | N | N | Y | |
| H222 | 2016h | h | (Multi-limit speed pattern at rated speed x 2.0) (Available soon) | 1 | 0.1 to 100.0%<br>Specifies the torque level at the rated speed*2.0. | N | 50.0 | Y | Y | 2 | Y | N | N | Y | |

| Function code | Communications address: 485 No. | Communications address: Link No. | Name | Dir. | Data setting range | Change when running | Default setting | Data copying | Initialization | Format type | Drive control: VC w/ PG | Drive control: VC w/o PG | Drive control: V/f | Drive control: VC for PMSM | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H223 | 2017h | h | (Multi-limit speed pattern at rated speed x 2.5) (Available soon) | 1 | 0.1 to 100.0%<br>Specifies the torque level at the rated speed*2.5. | N | 40.0 | Y | Y | 2 | Y | N | N | Y | |
| H224 | 2018h | h | (Multi-limit speed pattern at rated speed x 3.0) (Available soon) | 1 | 0.1 to 100.0%<br>Specifies the torque level at the rated speed*3.0. | N | 33.3 | Y | Y | 2 | Y | N | N | Y | |
| H225 | 2019h | h | (Limit speed discrimination zone, Start speed) (Available soon) | 1 | 0.1 to 100.0%<br>Specifies the starting speed of the discrimination zone. The rated speed is assumed as 100%. | N | 75.0 | Y | Y | 2 | Y | N | N | Y | |
| H226 | 201Ah | h | (Limit speed discrimination zone, Completion speed) (Available soon) | 1 | 0.1 to 100.0%<br>Specifies the end speed of the discrimination zone. The rated speed is assumed as 100%. | N | 93.7 | Y | Y | 2 | Y | N | N | Y | |
| H227 | 201Bh | h | (Function definition 3) (Available soon) | 1 | 0 to 2<br>0: Calculate the limit speed for winding-up and winding-down individually<br>1: Drive winding-down operation using the last limited speed result<br>Enable the winding-down limit calculation under specific conditions<br>2: Drive winding-down operation using the last limited speed result<br>Limit the winding-down speed with the rated speed under specific conditions | N | 0 | Y | Y | 0 | Y | N | N | Y | |
| H228 | 201Ch | h | Load Inertia Magnification Setting | 0 | 0 to 2<br>0: 1 time (0.001 to 50.000 kg•m$^2$)<br>1: 10 times (0.01 to 500.00 kg•m$^2$)<br>2: 100 times (0.1 to 5000.0 kg•m$^2$)<br>Switches the magnification of the load inertia (H51, H52, H202, H205, H208, H211). | N | 0 | Y | Y | 193 | Y | N | N | Y | |
| H322 | 2116h | | Notch Filter 1 (Resonance frequency) | 6 | 10 to 2000 Hz | Y | 1000 | Y | Y | 0 | Y | Y | N | Y | |
| H323 | 2117h | | (Attenuation level) | 1 | 0 to 40 dB | Y | 0 | Y | Y | 0 | Y | Y | N | Y | |
| H324 | 2118h | | (Frequency range) | 1 | 0 to 3 | Y | 2 | Y | Y | 0 | Y | Y | N | Y | |
| H325 | 2119h | | Notch Filter 2 (Resonance frequency) | 1 | 10 to 2000 Hz | Y | 1000 | Y | Y | 0 | Y | Y | N | Y | |
| H326 | 211Ah | | (Attenuation level) | 1 | 0 to 40 dB | Y | 0 | Y | Y | 0 | Y | Y | N | Y | |
| H327 | 211Bh | | (Frequency range) | 1 | 0 to 3 | Y | 2 | Y | Y | 0 | Y | Y | N | Y | |

### 5.3.6 A codes (Alternative Motor Parameter Functions M2/M3)

### 5.3.7 o codes (Option Functions)

### 5.3.8 L codes (Lift Functions)

### 5.3.9 SF codes (Safety Functions)

📖 For details of the above function code data, refer to the FRENIC-VG User's Manual Chapter 4, Section 4.2 "Function Codes Tables".

📖 For details of the function code data, refer to the FRENIC-VG User's Manual Chapter 4, Section 4.3 "Details of Function Codes".

# Chapter 6 TROUBLESHOOTING

## 6.1 Protective Functions

The FRENIC-VG series of inverters has various protective functions as listed below to prevent the system from going down and reduce system downtime. The protective functions marked with an asterisk (*) in the table are disabled by default. Enable them according to your needs.

The protective functions include, for example, the "heavy alarm" detection function which, upon detection of an abnormal state, displays the alarm code and causes the inverter to trip, the "light alarm" detection function which displays the alarm code but lets the inverter continue the current operation, and other warning signal output functions.

If any problem arises, understand the protective functions listed below and follow the procedures given in Section 6.2 and onwards for troubleshooting.

| Protective function | Description |
|---|---|
| "Heavy alarm" detection | This function detects an abnormal state, displays the corresponding alarm code, and causes the inverter to trip. The "heavy alarm" codes are check-marked in the "Heavy alarm" object column in Table 6.3-1. For details of each alarm code, see the corresponding item in the troubleshooting.<br>The inverter retains the latest and the last 10 alarm codes (see Section 3.4.9) and the latest and the last three pieces of alarm information (see Section 3.4.8). It can also display them. |
| "Light alarm" detection* | This function detects an abnormal state categorized as a "light alarm," displays L-AL and lets the inverter continue the current operation without tripping.<br>It is possible to define which abnormal states should be categorized as a "light alarm" using function codes H81 and H82. The "light alarm" codes are check-marked in the "Light alarm" object column in Table 6.3-1.<br>For instructions on how to check and release light alarms, see Section 3.3.5 "Monitoring light alarms, ■ How to remove the current light alarm." |
| Stall prevention | When the torque command exceeds the torque limiter level (F44, F45) during acceleration/ deceleration or constant speed running, this function limits the motor torque generated in order to avoid an overcurrent trip. |
| Automatic lowering of carrier frequency | Before the inverter trips due to an abnormal surrounding temperature or output current, this function automatically lowers the carrier frequency to avoid a trip. |
| Motor overload early warning* | When the inverter output current has exceeded the specified level, this function issues the "Motor overload early warning" signal [M-OL] before the thermal overload protection function causes the inverter to trip for motor protection. |
| Auto-reset* | When the inverter has stopped because of a trip, this function allows the inverter to automatically reset and restart itself. (The number of retries and the latency between stop and reset can be specified.) |
| Surge protection | This function protects the inverter from a surge voltage invaded between main circuit power lines and the ground. |

## 6.2 Before Proceeding with Troubleshooting

**⚠ WARNING ⚠**

- If any of the protective functions has been activated, first remove the cause. Then, after checking that the all run commands are set to OFF, release the alarm. If the alarm is released while any run commands are set to ON, the inverter may supply the power to the motor, running the motor.

  **Injury may occur.**

- Even if the inverter has interrupted power to the motor, if the voltage is applied to the main circuit input terminals L1/R, L2/S and L3/T, voltage may be output to inverter output terminals U, V, and W.
- **Turn OFF the power and wait at least five minutes for inverters with a capacity of 22 kW or below, or at least ten minutes for inverters with a capacity of 30 kW or above.** Make sure that the LED monitor and charging lamp are turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P (+) and N (-) has dropped to the safe level (+25 VDC or below).

  **Electric shock may occur.**

Follow the procedure below to solve problems.

(1) First, check that the inverter is correctly wired, referring to Chapter 2, Section 2.3.5 "Wiring of main circuit terminals and grounding terminals."

(2) Check whether an alarm code or the "light alarm" indication ( ) is displayed on the LED monitor.

- If an alarm code appears on the LED monitor ⟶ Go to Section 6.3.
- If the "light alarm" indication ( ) appears on the LED monitor ⟶ Go to Section 6.4.
- If neither an alarm code nor "light alarm" indication () appears on the LED monitor

  Abnormal motor operation ⟶ Go to Section 6.5.1.

  [ 1 ] The motor does not rotate.
  [ 2 ] The motor rotates, but the speed does not change.
  [ 3 ] The motor runs in the opposite direction to the command.
  [ 4 ] Speed fluctuation or current oscillation (e.g., hunting) occurs during running at constant speed.
  [ 5 ] Grating sound is heard from the motor or the motor sound fluctuates.
  [ 6 ] The motor does not accelerate or decelerate within the specified time.
  [ 7 ] The motor does not restart even after the power recovers from a momentary power failure.
  [ 8 ] The motor abnormally heats up.
  [ 9 ] The motor does not run as expected.
  [ 10 ] When the motor accelerates or decelerates, the speed is not stable.
  [ 11 ] The motor stalls during acceleration.
  [ 12 ] When the T-Link communications option is in use, neither a run command nor a speed command takes effect.
  [ 13 ] When the SX-bus communications option is in use, neither a run command nor a speed command takes effect.
  [ 14 ] When the CC-Link communications option is in use, neither a run command nor a speed command takes effect.
  [ 15 ] _ _ _ _ (under bars) appears.

  Problems with inverter settings ⟶ Go to Section 6.5.2.

  [ 1 ] Nothing appears on the monitors.
  [ 2 ] The desired function code does not appear.
  [ 3 ] Data of function codes cannot be changed from the keypad.
  [ 4 ] Data of function codes cannot be changed via the communications link.

If any problems persist after the above recovery procedure, contact your Fuji Electric representative.

## 6.3 If an alarm code appears on the LED monitor

### 6.3.1 List of alarm codes

If the inverter detects an alarm, check whether any alarm code appears on the 7-segment LED monitor of the keypad.

As listed below, some alarm codes are followed by alarm sub codes that denote the detailed error causes. For alarm codes not followed by alarm sub codes, "--" is written in the table below.

* For the alarm sub code checking procedure, refer to Section 3.4.4.8 "Reading alarm information--Menu #7 "ALM INF."

* For alarm codes followed by alarm sub codes listed as "For particular manufacturers," inform your Fuji Electric representative of the alarm sub code also when contacting or asking him/her to repair the inverter.

Table 6.3-1 Abnormal States Detectable ("Heavy Alarm" and "Light Alarm" Objects)

| Num. | LED monitor displays | Name | Description | Alarm sub code * | Detailed error cause * | Related function code |
|---|---|---|---|---|---|---|
| [1] | dbA | Braking transistor broken | If a breakdown of the braking transistor is detected, this protective function stops the inverter output. (Available for braking transistor built-in inverters)<br>If this alarm is detected, be sure to shut down the power on the primary side of the inverter. | - | - | H103 |
| [2] | dbH | Braking resistor overheated | This function estimates the temperature of the braking resistor and stops the inverter output if the temperature exceeds the allowable value.<br>It is necessary to configure Function codes E35 to E37 depending on the resistor (integrated or externally mounted). | - | - | E35 to E37 |
| [3] | dCF | DC fuse blown | If a fuse in the main DC circuit blows due to a short circuit in the IGBT circuit, this protective function displays the error to prevent the secondary damage. The inverter could be broken, so immediately contact your Fuji Electric representative.<br>(For models of 75 kW or above in 200 V class series and 90 kW or above in 400 V class series) | - | - | |
| [4] | dFA | DC fan locked | This function is activated if the DC fan is stopped.<br>(For models of 45 kW or above in 200 V class series and 75 kW or above in 400 V class series) | - | - | H108 |
| [5] | dE | Excessive positioning deviation | This function is activated when the positioning deviation between the command and the detected values exceeds the setting of Function code o18 (Excessive deviation value) in synchronous operation.<br>Mounting an option makes the option codes "o" effective and displays them on the keypad. | - | - | o18 |
| [6] | EC | PG communication error | This function is activated if a PG communication error occurs when the 17-bit high resolution ABS interface (OPC-VG1-SPGT) is used. | 0001 to 2000 | For manufacturers * | |
| [7] * | ECF | Functional safety circuit fault | This function detects a functional safety circuit fault and stops the inverter. The alarm cannot be removed by the inverter's reset function. | 0001 | Input mismatch between terminals [EN1] and [EN2] | |
| | | | | 0002 | Printed circuit board failure | |
| | | | | 0005 to 0008 | CPU error | |

| Num. | LED monitor displays | Name | Description | Alarm sub code * | Detailed error cause * | Related function code |
|---|---|---|---|---|---|---|
| [8] | EF | Ground fault | This function is activated when a ground fault is detected in the inverter output circuit. If the ground-fault current is large, the overcurrent protection may be activated.<br>This protective function is to protect the inverter. For the sake of prevention of accidents such as human damage and fire, connect a separate earth-leakage protective relay or an earth-leakage circuit breaker (ELCB). | - | - | H103 |
| [9] | Er 1 | Memory error | This function is activated when a memory error such as a data write error occurs.<br>**Note:** The inverter memory uses a nonvolatile memory that has a limited number of rewritable times (100,000 to 1,000,000 times). Saving data with the full save function into the memory so many times unnecessarily will no longer allow the memory to save data, causing a memory error. | 0001 to 0008 | For manufacturers * | |
| [10] | Er2 | Keypad communications error | This function is activated if a communications error occurs between the keypad and the inverter control circuit when the start/stop command given from the keypad is valid (Function code F02=0).<br>**Note:** Even if a keypad communications error occurs when the inverter is being driven via the control circuit terminals or the communications link, the inverter continues running without displaying any alarm or issuing an alarm output (for any alarm). | 0001 | Wire break detected | F02 |
| | | | | 0002 | Wire break detected (during keypad operation) | |
| [11] | Er3 | CPU error | This function is activated if a CPU error occurs. | 0001 to 0008 | For manufacturers * | |
| [12] | Er4 | Network error | This function is activated:<br>- if a communications error occurs due to noise when the inverter is being driven via the T-Link, SX-bus, E-SX bus, or CC-Link. | 0001 to 0004 | See the FRENIC-VG User's Manual, Chapter 6. | o30, o31, H107, E01 to E14, E15 to E28 |
| [13] | Er5 | RS-485 communications error | This function is activated:<br>- if an RS-485 communications error occurs when the inverter is being driven via the RS-485 and Function code H32 is set to any of "0" through "2."<br>- if Function code H38 is set within the range of 0.1 to 60.0 (s) and the communications link breaks for the specified period or longer. | 0001 | Communications error (timeout) | H32, H33, H38, H107 |
| | | | | 0002 | Communications error (transmission error) | |

| Num. | LED monitor displays | Name | Description | Alarm sub code * | Detailed error cause * | Related function code |
|---|---|---|---|---|---|---|
| [14] | Er5 | Operation error | This function is activated:<br>- if two or more network options (T-Link, SX-bus, E-SX bus, and CC-Link) are mounted.<br>- if the SW configuration is the same on two or more PG options. (More than one PG option can be mounted.)<br>- if auto tuning (Function code H01) is attempted when any of the digital input signals **BX**, ***STOP1***, ***STOP2*** and ***STOP3*** is ON.<br>- if auto tuning is selected with Function code H01 but the FWD key on the keypad is not pressed within 20 seconds. | 0001 | Option mounting error | H01 |
| | | | | 0002 | Auto-tuning failed | |
| | | | | 0008 | For manufacturers * | |
| [15] | Er7 | Output wiring fault | This function is activated if the wires in the inverter output circuit are not connected during auto-tuning. | 0001 | Output wiring fault during tuning | H01 |
| | | | | 0002 | Speed not arrived during tuning with the motor running | |
| | | | | 0004 to 0008 | For manufacturers * | |
| [16] | Er8 | A/D converter error | This function is activated if an error occurs in the A/D converter circuit. | 0001 to 0004 | For manufacturers * | |
| [17] | Er9 | Speed not agreed | This function is activated if the deviation between the speed command (reference speed) and the motor speed (detected or estimated speed) becomes excessive.<br>The detection level and detection time can be specified with function codes. | 0001 | Motor 1 speed not agreed | E43, E44, E45, H108, H149 |
| | | | | 0002 | Motor 2 speed not agreed | |
| | | | | 0003 | Motor 3 speed not agreed | |
| | | | | 0004 | Machine runaway detected (by H149) | |
| [18] | ErA | UPAC error | Activated on a hardware fault in the UPAC option or a communication error between the inverter control circuit and the UPAC optin. | 0001 to 0004 | See the related option manual. | H108 |
| [19] | Erb | Inter-inverter communications link error | This function is activated if a communications error occurs in the inverter-to-inverter communications link using a high-speed serial communication terminal block (option). (Available soon) | - | - | H107 |
| [20] | ErH | Hardware error | Upon detection of an LSI failure on the printed circuit board, this function stops the inverter output. | 0001 to 1000 | For manufacturers * | |
| [21] | Err | Mock alarm | This can be caused with keypad operation or FRENIC-VG Loader. | - | - | H108, H142 |
| [22] | Et1 | PG failure | This function is activated if a PG data error or PG failure is detected when the 17-bit high resolution ABS interface (OPC-VG1-SPGT) is used. | - | - | |
| [23] | Lin | Input phase loss | This function protects the inverter when an input phase loss is detected. If the connected load is light or a DC reactor is connected to the inverter, this function may not detect input phase loss if any. | - | - | E45 |
| [24] | LOC | Start delay | This function is activated when the reference torque current (F44, F45) exceeds the specified level (H140) and the detected speed or reference one drops below the specified stop speed (F37) and the state is kept for the specified duration (H141). | - | - | H108, H140, H141 |

| Num. | LED monitor displays | Name | Description | Alarm sub code * | Detailed error cause * | Related function code |
|---|---|---|---|---|---|---|
| [25] | LU | Undervoltage | This function is activated when the DC link bus voltage drops below the undervoltage detection level (180 VDC for 200 V series, 360 VDC for 400 V series).<br>Note that, if the restart mode after momentary power failure is selected (F14 = 3, ,4 or 5), no alarm is output even if the DC link bus voltage drops. | - | - | F14 |
| [26] | nrb | NTC wire break error | This function is activated if the thermistor wire breaks when the NTC thermistor is selected with Function code P30/A31/A131 for motor M1/M2/M3.<br>This function works even at extremely low temperatures (approx. -30°C or below). | - | - | P30, A31, A131, H106 |
| [27] * | OC | Overcurrent | This function stops the inverter output when the output current to the motor exceeds the overcurrent level of the inverter. | 0001 to 0004 | For manufacturers * | |
| | | | | 0100 | Demagnetizing limit current for PMSM | |
| [28] * | OH1 | Heat sink overheat | This function is activated if the temperature surrounding the heat sink (that cools down the rectifier diodes and the IGBTs) increases due to stopped cooling fans. | 0001 to 0008 | Protection by thermistor | |
| | | | | 0010 to 0200 | For manufacturers * | |
| [29] * | OH2 | External alarm | This function is activated by digital input signal ***THR*** ("Enable external alarm trip").<br>Connecting an alarm contact of external equipment such as a braking unit or braking resistor to the control circuit terminal (to which the ***THR*** is assigned) activates this function according to the contact signal status. | 0001 | Protection by ***THR*** signal | E01 to E14,<br>H106 |
| [30] | OH3 | Inverter internal overheat | This function is activated if the temperature surrounding the control printed circuit board increases due to poor ventilation inside the inverter. | 0001 to 0008 | Protection by thermistor | |
| | | | | 0010 | For manufacturers * | |
| [31] | OH4 | Motor overheat | This function is activated if the temperature detected by the NTC thermistor integrated in a dedicated motor for motor temperature detection exceeds the motor overheat protection level (E30). | - | - | E30, H106 |
| [32] | OL 1 | Motor 1 overload | This function is activated by the electronic thermal overload protection if the motor 1 current (inverter output current) exceeds the operation level specified by Function code F11. | - | - | F11, H106 |
| [33] | OL2 | Motor 2 overload | This function is activated by the electronic thermal overload protection if the motor 2 current (inverter output current) exceeds the operation level specified by Function code A33. | - | - | A33, H106 |
| [34] | OL3 | Motor 3 overload | This function is activated by the electronic thermal overload protection if the motor 3 current (inverter output current) exceeds the operation level specified by Function code A133. | - | - | A133, H106 |
| [35] * | OLU | Inverter overload | This function is activated if the output current exceeds the overload characteristic of the inverse time characteristic.<br>It stops the inverter output depending upon the heat sink temperature and switching element temperature calculated from the output current. | 0001 to 0002 | For manufacturers * | F80 |

| Num. | LED monitor displays | Name | Description | Alarm sub code * | Detailed error cause * | Related function code |
|---|---|---|---|---|---|---|
| [36] | OPL | Output phase loss | This function detects a break in inverter output wiring during running and stops the inverter output.<br>(Available under vector control for IM with speed sensor.) | 0001 | Loss of one or more phases | H103, P01, A01, A101 |
| | | | | 0002 | Loss of two or more phases | |
| [37] | OS | Overspeed | This function<br>Stops the inverter output if the detected speed is 120% or over of the maximum speed.<br>This function is activated if the motor speed (detected or estimated speed) exceeds 120% (adjustable with Function code H90) of the maximum speed (F03/A06/A106). | - | - | H90 |
| [38] * | OU | Overvoltage | This function is activated if the DC link bus voltage exceeds the overvoltage detection level (405 VDC for 200 V series, 820 VDC for 400 V series) due to an increase of supply voltage or regenerative braking current from the motor.<br>Note that the inverter cannot be protected from excessive voltage (high voltage, for example) supplied by mistake. | 0001 | For manufacturers * | |
| [39] | PG | PG wire break | This function is activated if a wire breaks in the PA/PB circuit on the PG terminal or in the power supply circuit.<br>It does not work under vector control without speed sensor or under V/f control. | 0001 | Wire break detected (inverter unit, PA and PB) | H104 |
| | | | | 0002 | Wire break detected (option) | |
| | | | | 0004 | Power shutdown detected (inverter unit) | |
| [40] | PbF | Charger circuit fault | This function is activated if the bypass circuit of the DC link bus is not configured (that is, the magnetic contactor for bypass of the charging circuit is not closed) even after the main power is applied.<br>(For models of 37 kW or above in 200 V class series and 75 kW or above in 400 V class series) | 0001 to 0002 | For manufacturers * | |
| [41] | A-E | E-SX bus tact synchronization error | This error occurs when the E-SX tact cycle and inverter control cycle are out of synchronization with each other. | - | - | H108 |
| [42] | A-F | Toggle data error | The inverter monitors 2-bit signals of toggle signal 1 ***TGL1*** and toggle signal 2 ***TGL2*** which are sent from the PLC.<br>When the inverter receives no prescribed change pattern within the time specified by H144, this error occurs. | - | - | H107 |
| [43] | S1F | Functional safety card fault | Refer to the Functional Safety Card instruction manual for details. | - | See the Functional Safety Card (OPC-VG1-SAFE) instruction manual. | |
| [44] | S-F | | This alarm cannot be removed by the inverter's reset function.<br>For details, refer to the Functional Safety Card instruction manual. | - | | |

| Num. | LED monitor displays | Name | Description | Alarm sub code * | Detailed error cause * | Related function code |
|---|---|---|---|---|---|---|
| [45] | L -AL | Light alarm (warning) | This function displays L -AL on the LED monitor if a failure or warning registered as a light alarm occurs. It outputs the ***L-ALM*** signal on the Y terminal but it does not issue an alarm relay output ([30A], [30B], [30C]), so the inverter continues to run.<br><u>Light alarm objects (selectable)</u><br>Motor overheat (OH4), Motor overload (OL 1 to OL3 ),<br>NTC wire break error (n-b ), External failure (OH2),<br>RS-485 communications error (Er5 ),<br>Network error (Er4),<br>Toggle data error (PI-F ), Mock alarm (Err ),<br>DC fan locked (dFA), Speed mismatch (Er9),<br>E-SX bus tact synchronization error (PI-E ),<br>Motor overheat early warning (MOH),<br>Motor overload early warning (MOL),<br>Lifetime alarm (LiF),<br>Heat sink overheat early warning (OH),<br>Inverter overload early warning (OL),<br>Battery life expired (BAT ), Start delay (LOL )<br>Functional safety card light alarms (SnF ):Alarms that could occur in the functional safety card. An individual alarm is not selectable as a light alarm object.<br>Light alarm objects can be checked on the keypad. | - | - | H106 to H108,<br>H110, H111<br>SF25 to SF27<br>(Only SnF) |
| [46] | – | Surge protection | This function protects the inverter against surge voltages which might appear between one of the power lines, using surge absorbers connected to the main circuit power terminals (L1/R, L2/S, L3/T) and control power terminals (R0, T0). | - | - | |
| [47] | – | Main Power Shutdown Detection | This function monitors the AC input power to the inverter and judges whether the AC input power (main power) is established.<br>When the main power is not established, whether to run the inverter or not can be selected.<br>(When the power is supplied via a PWM converter or the DC link bus, there is no AC input. In this case, do not chang | - | - | H76 |

**Notes**
- All protective functions are automatically reset if the control power voltage decreases until the inverter control circuit no longer operates.
- The inverter retains the latest and the last 10 alarm codes and the latest and the last three pieces of alarm information.
- Stoppage due to a protective function can be reset by the RST key on the keypad or turning OFF and then ON between the X terminal (to which RST is assigned) and the CM. This action is invalid if the cause of an alarm is not removed.
- The inverter cannot reset until the causes of all alarms are removed. (The causes of alarms not removed can be checked on the keypad.)
- If an abnormal state is categorized as a light alarm, the 30A/B/C does not operate.

### 6.3.2 Possible causes of alarms, checks and measures

#### [ 7 ] ECF Functional safety circuit fault

① Alarm sub code: 0001

Problem An error occurred in Enable input circuit.

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) Poor contact of the control circuit terminal block | Check that the control circuit terminal block is secured to the inverter. |
| (2) Enable input circuit logic error | Check the ON/OFF timings of [EN1] and [EN2] with Menu #4 "I/O CHECK."<br>➔ Check that jumper bars are mounted between terminals [EN1] and [PS] and between [EN2] and [PS].<br>➔ Operate the relay so that the ON/OFF timings of [EN1] and [EN2] are synchronized.<br>➔ Check whether the relay(s) are not welded. If welded, replace the relay.<br>➔ Check the gap between the ON/OFF timings of [EN1] and [EN2]. Keep the gap within 50 ms. |
| (3) Enable input circuit fault | Take the measures given in (2) above.<br>➔ If the error persists, ask your Fuji Electric representative to repair the inverter. Inform the representative of the alarm sub code displayed. |

② Alarm sub code: 0002, 0005 to 0008

Problem The printed circuit board(s) or CPU is faulty.

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) Inverter affected by strong electrical noise. | Check if appropriate noise control measures have been implemented (e.g. correct grounding and routing of signal wires, communications cables, and main circuit wires).<br>➔ Implement noise control measures. |
| (2) Short circuit on the printed circuit board(s).<br>[Sub code: 0001 to 0008] | Check the printed circuit board(s) for short circuits, accumulation of dust or dirt.<br>➔ Ask your Fuji Electric representative to repair the inverter. Inform the representative of the alarm sub code displayed. |

Note To remove the Er-3 CPU error, turn the power to the inverter OFF and then ON. The error cannot be removed by pressing the RESET key.

#### [ 27 ] OC Overcurrent

Problem The inverter momentary output current exceeded the overcurrent level.

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) The inverter output lines were short-circuited. | Disconnect the wiring from the inverter output terminals ([U], [V] and [W]) and measure the interphase resistance of the motor wiring. Check if the resistance is too low.<br>➔ Remove the short-circuited part (including replacement of the wires, relay terminals and motor). |
| (2) Ground faults have occurred at the inverter output lines. | Disconnect the wiring from the output terminals [U], [V] and [W] and perform a Megger test for the inverter and the motor. (Refer to Section 7.6 "Insulation Test.")<br>➔ Remove the grounded parts (including replacement of the wires, relay terminals and motor). |
| (3) Overload. | Measure the motor current with a measuring device to trace the current trend. Then, use this data to judge if the trend is over the calculated load value for your system design.<br>➔ If the load is too heavy, reduce it or increase the inverter capacity.<br>Trace the current trend and check if there are any sudden changes in the current.<br>➔ If there are any sudden changes, make the load fluctuation smaller or increase the inverter capacity.<br>➔ Under V/f control<br>Enable overcurrent limiting (H58 = 1). |
| Under V/f control<br>(4) Excessive torque boost specified (in the case of manual torque boost) | Check whether decreasing the torque boost (P35, A55, A155) decreases the output current but does not stall the motor.<br>➔ If no stall occurs, decrease the torque boost (P35, A55, A155). |

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| Under V/f control<br>(5) The acceleration/deceleration time was too short. | Check that the motor generates enough torque required during acceleration/deceleration. That torque is calculated from the moment of inertia for the load and the acceleration/deceleration time.<br>➔ Increase the acceleration/deceleration time (F07, F08, C46, C47, C56, C57, C66, C67).<br>➔ Increase the inverter capacity.<br>➔ Review the braking method. |
| (6) Malfunction caused by noise. | Check if noise control measures are appropriate (e.g., correct grounding and routing of control and main circuit wires).<br>➔ Implement noise control measures. For details, refer to the FRENIC-VG User's Manual, "Appendix A."<br>➔ Enable the Auto-reset (H04).<br>➔ Connect a surge absorber to magnetic contactor's coils or other solenoids (if any) causing noise. |
| Under vector control with/without speed sensor<br>(7) The carrier frequency is low. | Check the motor sound (carrier frequency) specified by F26.<br>➔ Increase the setting of F26.<br>(Note that increasing the carrier frequency excessively may cause other devices to malfunction due to noise generated from the inverter.) |
| Under vector control with/without speed sensor<br>(8) Exciting current was too small during auto-tuning. | Check whether it happens during auto-tuning.<br>➔ Increase the exciting current (P08, A10, A110) and then perform auto-tuning. |
| Under vector control with speed sensor<br>(9) Mismatch between the PG's pulse resolution and the function code setting. | Check the function code setting (P28, A30, A130).<br>➔ Match the function code settings with the PG specifications. |
| Under vector control with speed sensor<br>(10) Wrong wiring of the PG. | Check the wiring between the PG and the inverter for the phase sequence, wire breaks, shielding and twisting.<br>➔ Correct the wiring. |
| Under vector control with speed sensor<br>(11) PG defective. | Check whether the inverter internal control circuit (PG input circuit) is faulty, using the self-diagnosis function of the PG detection circuit (H74).<br>➔ If the result is "Normal," replace the PG; if it is "Abnormal," contact your Fuji Electric representative.<br>Check the PG waveform using an oscilloscope.<br>➔ Replace the PG. |

### [ 28 ] OH1 Heat sink overheat

Problem Temperature around heat sink has risen abnormally.

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) The surrounding temperature exceeded the range of the inverter specification.<br>[Sub code: 0001 to 0008] | Measure the temperature around the inverter.<br>➔ Lower the temperature around the inverter (e.g., ventilate the panel where the inverter is mounted). |
| (2) Ventilation path is blocked.<br>[Sub code: 0001 to 0008] | Check if there is sufficient clearance around the inverter.<br>➔ Change the mounting place to ensure the clearance. |
| | Check if the heat sink is not clogged.<br>➔ Clean the heat sink.<br>(For the cleaning procedure, contact your Fuji Electric representative.) |
| (3) Cooling fan's airflow volume decreased due to the service life expired or failure.<br>[Sub code: 0001 to 0008]<br>[Sub code: 0010 to 0200] | Check the cumulative run time of the cooling fan. Refer to FRENIC-VG User's Manual Chapter 3, Section 3.4.4.6 "Reading maintenance information – Menu #5 MAINTENANCE."<br>➔ Replace the cooling fan.<br>(Contact your Fuji Electric representative.) |
| | Visually check whether the cooling fan rotates normally.<br>➔ Replace the cooling fan.<br>(Contact your Fuji Electric representative.) |

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (4) Overload.<br>[Sub code: 0001 to 0008] | Measure the output current.<br>➔ Reduce the load (Use the heat sink overheat early warning ***INV-OH*** (E15 through E27) or the inverter overload early warning ***INV-OL*** (E15 through E27) to reduce the load before the overload protection is activated.).<br>➔ Decrease the data of F26 (Motor sound, Carrier frequency). |

### [ 29 ] OH2 External alarm

Problem External alarm was inputted (***THR***).
(when the "Enable external alarm trip" ***THR*** has been assigned to any of digital input terminals)

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) An alarm function of external equipment was activated. | Check the operation of external equipment.<br>➔ Remove the cause of the alarm that occurred. |
| (2) Wrong connection or poor contact in external alarm signal wiring. | Check if the external alarm signal wiring is correctly connected to the terminal to which the "Enable external alarm trip" terminal command ***THR*** has been assigned (Any of E01 through E09 should be set to "9.").<br>➔ Connect the external alarm signal wire correctly. |
| (3) Incorrect setting of function code data. | Check whether the normal/negative logic of the external signal matches that of the ***THR*** command specified by E14.<br>➔ Ensure the matching of the normal/negative logic. |
| (4) The surrounding temperature exceeded the range of the braking resistor specification. | Measure the temperature around the braking resistor.<br>➔ Lower the temperature (e.g., ventilate the inverter). |
| (5) The capacity of the braking resistor is insufficient. | Reconsider the capacity and %ED of the braking resistor.<br>➔ Review the braking resistor. |

### [ 35 ] OLU Inverter overload

Problem Electronic thermal overload protection for inverter activated.

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) The surrounding temperature exceeded the range of the inverter specification. | Measure the temperature around the inverter.<br>➔ Lower the temperature (e.g., ventilate the panel where the inverter is mounted). |
| (2) Excessive torque boost specified. | Check whether decreasing the torque boost (P35, A55, A155) does not stall the motor.<br>➔ If no stall occurs, decrease the torque boost (P35, A55, A155). |
| (3) The specified acceleration/ deceleration time was too short. | Recalculate the acceleration/deceleration torque and time needed for the load, based on the moment of inertia for the load and the acceleration/deceleration time.<br>➔ Increase the acceleration/deceleration time (F07, C35, C46, C56, C66). |
| (4) Overload. | Measure the load factor to see that it does not exceed 100%. (Refer to Section 3.4.7 "Measuring load factor -- Menu #6 "LOAD FCTR."<br>➔ Reduce the load (e.g., Use the overload early warning (E33) and reduce the load before the overload protection is activated.).<br>➔ Decrease the motor sound (Carrier frequency) (F26). |
| (5) Ventilation paths are blocked. | Check if there is sufficient clearance around the inverter.<br>➔ Change the mounting place to ensure the clearance.<br>(For details, refer to Chapter 2, Section 2.2 "Installing the Inverter." |
| | Check if the heat sink is not clogged.<br>➔ Clean the heat sink.<br>(For the cleaning procedure, contact your Fuji Electric representative.) |
| (6) Cooling fan's airflow volume decreased due to the service life expired or failure. | Check the cumulative run time of the cooling fan.<br>➔ Replace the cooling fan.<br>(Contact your Fuji Electric representative.) |
| | Visually check that the cooling fan rotates normally.<br>➔ Replace the cooling fan.<br>(Contact your Fuji Electric representative.) |
| (7) The wires to the motor are too long, causing a large leakage current from them. | Measure the leakage current.<br>➔ Insert an output circuit filter (OFL). |

| | |
|---|---|
| Under vector control with/without speed sensor<br>(8) Reference speed fluctuating | Check whether the reference speed is fluctuating.<br>➔ Increase the ASR input filter setting (F64, C43, C53, C63). |
| Under vector control with/without speed sensor<br>(9) The control constants of the automatic speed regulator (ASR) are inadequate. | Check whether the actual speed overshoots or undershoots the commanded one.<br>➔ Readjust the ASR (ASR gain, constant of integration, etc.). |
| (10) Wrong wiring to the PG. | Check the wiring to the PG.<br>➔ Correct the wiring. (Refer to Section 4.2.2 "Mounting direction of a pulse generator (PG) and PG signals.") |
| (11) Wrong wiring to the motor. | Check the wiring to the motor.<br>➔ Correct the wiring.<br>It is also possible to use H75 (Phase sequence configuration of main circuit output wires). |
| (12) The magnetic pole position of the permanent magnet synchronous motor (PMSM) is out of place. | Check the magnetic pole position.<br>➔ Adjust the magnetic pole position (o10, A60, A160).<br>(Refer to Section 4.3.3 "Vector control for PMSM with speed sensor and magnetic pole position sensor," ■ Adjusting the magnetic pole position.") |

### [ 38 ] 0U Overvoltage

Problem The DC link bus voltage exceeded the overvoltage detection level.

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) The power supply voltage exceeded the range of the inverter specification. | Measure the input voltage.<br>➔ Decrease the voltage to within the specified range. |
| (2) A surge current entered the input power supply. | In the same power line, if a phase-advancing capacitor is turned ON/OFF or a thyristor converter is activated, a surge (momentary large increase in the voltage or current) may be caused in the input power.<br>➔ Install a DC reactor. |
| (3) The deceleration time was too short for the moment of inertia of the load. | Recalculate the deceleration torque based on the moment of inertia of the load and the deceleration time.<br>➔ Increase the deceleration time (F08, C36, C47, C57, C67).<br>➔ Consider the use of a braking resistor or PWM converter (RHC-C).<br>➔ Decrease the moment of inertia of the load.<br>➔ Enable the overvoltage trip prevention (H57).<br>➔ Select the power limit function (F40 = 2).<br>➔ Under vector control with speed sensor<br>Enable the torque limiter (F40 to F45). |
| (4) The acceleration time was too short. | Check if an overvoltage alarm occurs after rapid acceleration.<br>➔ Increase the acceleration time (F07, C35, C46, C56, C66).<br>➔ Select the S-curve acceleration/deceleration (F67 to F70).<br>➔ Consider the use of a braking resistor or PWM converter (RHC-C).<br>➔ Decrease the moment of inertia of the load. |
| (5) Braking load was too heavy. | Compare the braking torque of the load with that of the inverter.<br>➔ Consider the use of a braking resistor or PWM converter (RHC-C). |
| (6) Malfunction caused by noise. | Check if the DC link bus voltage was below the protective level when the overvoltage alarm occurred.<br>➔ Implement noise control measures. For details, refer to the FRENIC-VG User's Manual, "Appendix A."<br>➔ Enable the auto-reset (H04).<br>➔ Connect a surge absorber to magnetic contactor's coils or other solenoids (if any) causing noise. |
| (7) The inverter output lines were short-circuited. | Disconnect the wiring from the inverter output terminals ([U], [V] and [W]) and measure the interphase resistance of the motor wiring. Check if the resistance is too low.<br>➔ Remove the short-circuited part (including replacement of the wires, relay terminals and motor). |
| (8) Wrong connection of the braking resistor. | Check the connection.<br>➔ Correct the connection. |
| (9) Large, rapid decrease of the load. | Check whether the inverter runs at the time of rapid decrease of the load.<br>➔ Consider the use of a braking resistor or PWM converter (RHC-C). |

## 6.4 If the "Light Alarm" Indication (L -AL) Appears on the LED Monitor

If the inverter detects a minor abnormal state "light alarm," it can continue the current operation without tripping while displaying the "light alarm" indication L -AL on the LED monitor. In addition to the indication L -AL, the inverter blinks the KEYPAD CONTROL LED and outputs the "light alarm" signal ***L-ALM*** to a general-purpose digital output terminal to alert the peripheral equipment to the occurrence of a light alarm. (To use the ***L-ALM***, it is necessary to assign the signal to any of the digital output terminals by setting any of function codes E15 through E19 to "57.")

Function codes H106 through H110 specify which alarms should be categorized as "light alarm." The available "light alarm" codes are check-marked in the "Light alarm" object column in Table 6.3-1.

For the "light alarm" factors and the alarm removal procedure, refer to Chapter 3, Section 3.3.5 "Monitoring light alarms."

Note that light alarms SnF that could occur in the functional safety card OPC-VG1-SAFE cannot be selected by function codes H106 through H110. For details about SnF, refer to the Functional Safety Card instruction manual.

## 6.5 If Neither an Alarm Code Nor "Light Alarm" Indication (L -AL) Appears on the LED Monitor

### 6.5.1 Abnormal motor operation

**[ 1 ] The motor does not rotate.**

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) No power supplied to the inverter. | Check the input voltage and interphase voltage unbalance.<br>➔ Turn ON a molded case circuit breaker (MCCB), a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) or a magnetic contactor (MC).<br>➔ Check for voltage drop, phase loss, poor connections, or poor contacts, and fix them if necessary.<br>➔ If only the auxiliary control power input is supplied, also supply the main power to the inverter. |
| (2) No run forward/reverse command was inputted, or both the commands were inputted simultaneously (external signal operation). | Check the input status of the forward/reverse command with Menu #4 "I/O CHECK" using the keypad.<br>➔ Input a run command.<br>➔ Set either the forward or reverse operation command to off if both commands are being inputted.<br>➔ Correct the run command source. (Set the data of F02 to "1.")<br>➔ Connect the external circuit wires to control circuit terminals [FWD] and [REV] correctly.<br>➔ Make sure that the sink/source slide switch (SW1) on the control printed circuit board (control PCB) is properly configured. (Refer to Section 2.3.11 "Setting up the slide switches.") |
| (3) A run command with higher priority than the one attempted was active, and the run command was stopped. Or, a speed command was active. | Referring to the run command block diagram given in the FRENIC-VG User's Manual, Chapter 4, check the higher priority run command using Menu #2 "DATA CHECK" and Menu #4 "I/O CHECK" with the keypad.<br>➔ Correct wrong setting of function code H30 (Communications link function, Mode selection) or cancel the higher priority run command. |
| (4) No analog speed command input. | Check whether the analog speed command is correctly inputted, using Menu #4 "I/O CHECK" on the keypad.<br>➔ Connect the external circuit wires to terminals [13], [12], [11], [Ai1] and [Ai2] correctly.<br>➔ Inspect the external speed command potentiometers, signal converters, switches and relay contacts. Replace any ones that are faulty. |
| Under V/f control<br>(5) The reference speed was below the starting or stop speed. | Check that a speed command has been entered correctly, using Menu #4 "I/O CHECK" on the keypad.<br>➔ Set the reference speed at the same or higher than the starting speed (F23).<br>➔ Reconsider the starting speed (F23), and if necessary, change it to the lower value.<br>➔ Inspect the external speed command potentiometers, signal converters, switches and relay contacts. Replace any ones that are faulty.<br>➔ Connect the external circuit wires to terminals [13], [12], [11], [Ai1] and [Ai2] correctly. |

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (6) A run command with higher priority than the one attempted was active. | Referring to the run command block diagram given in the FRENIC-VG User's Manual, Chapter 4, check the higher priority run command using Menu #2 "DATA CHECK" and Menu #4 "I/O CHECK" with the keypad.<br>➔ Correct the wrong setting of function codes (e.g., cancel the higher priority run command).<br>➔ Correct wrong setting of function code H30 (Communications link function, Mode selection) or cancel the higher priority run command. |
| (7) The speed limiter settings were made incorrectly. | Check the data of function codes F76 (Speed limiter mode), F77 and F78 (Speed limiter levels 1 and 2).<br>➔ Correct the data of F76 through F78. |
| (8) The coast-to-stop command was effective. | Check the data of function codes E01 through E09 and the input signal status of X terminals, using Menu #4 "I/O CHECK" on the keypad.<br>➔ Release the coast-to-stop command setting.<br>Check the input signal status of terminal [EN], using Menu #4 "I/O CHECK" on the keypad.<br>➔ Short-circuit the terminal [EN] with terminal [PS]. |
| (9) No input on [EN1] or [EN2]. | Check the input status of the EN terminal, using Menu #4 "I/O CHECK" on the keypad.<br>➔ Short-circuit each of [EN1] and [EN2] with [PS]. (Refer to Chapter 2, Section 2.3.9 "Detailed functions of control circuit terminals." |
| (10) Broken wires, incorrect connection or poor contact with the motor. Or the motor defective. | Check the wiring and the motor. (Measure the output current).<br>➔ Repair the wires to the motor, or replace them.<br>➔ Repair the motor or replace it. |
| (11) Overload | Measure the output current.<br>➔ Reduce the load (In winter, the load tends to increase.)<br>➔ Increase the inverter and motor capacities. |
| | Check whether any mechanical brake is activated.<br>➔ Release the mechanical brake, if any. |
| (12) Torque generated by the motor was insufficient. | Check that the motor switching signal (selecting motor 1, 2 or 3) is correct using Menu #4 "I/O CHECK" on the keypad and that the data of function codes matches each motor.<br>➔ Correct the motor switching signal.<br>➔ Modify the function code data to match the connected motor. |
| Under V/f control<br>(13) Torque generated by the motor was insufficient. | Check whether the reference speed is below the slip-compensated speed of the motor (Function codes P10 and P11 for M1, A12 and A13 for M2, and A112 and A113 for M3).<br>➔ Change the reference speed so that it becomes higher than the slip-compensated speed of the motor.<br>Check whether increasing the toque boost (Function code P35, A55, A155) starts rotating the motor.<br>➔ Increase the data of P35, A55 or A155.<br>Check the data of function code F04, A05 or A105.<br>➔ Change the V/f pattern setting to match each motor. |
| (14) Wrong connection or poor contact of DC reactor (DCR) | Check the wiring between the main circuit terminals P1 and P(+).<br>Inverters of 55 kW in LD mode and inverters of 75 kW or above come with a DCR as standard. Without connection of a DCR, these inverters cannot run.<br>➔ Connect a jumper bar or DCR correctly. Repair or replace wires to the DCR. |
| (15) No reference speed setting (keypad operation). | Check the reference speed setting made on the keypad.<br>➔ Modify the reference speed setting by pressing [↑] key. |
| (16) The inverter could not accept any run commands from the keypad since it was in Programming mode. | Check which operation mode the inverter is in, using the keypad.<br>➔ Shift the operation mode to Running mode and enter a run command. |
| Under vector control with speed sensor<br>(17) Incorrect setting of the number of poles of the motor | Check whether the setting of function code P05, A07 or A107 (No. of poles) matches the number of poles of the actual motor.<br>➔ Set the data of P05, A07 or A107 to the correct number of poles. |

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| Under vector control with speed sensor<br>(18) Wrong wiring between the motor and pulse generator (PG). | Check the motor wiring (phase sequence) and the polarity of the PG.<br>➔ Correct the wiring. (Refer to Chapter 4, Section 4.2.2 "Mounting direction of a PG (pulse generator) and PG signals.") |
| Under vector control with/without speed sensor<br>(19) Incorrect setting of the torque limiter level. | Check whether the torque limiter level (Function code F44, F45) is set to zero (0).<br>➔ Modify the data of F44 or F45 to the appropriate value. |
| Under vector control with/without speed sensor<br>(20) Incorrect setting of the torque command. | Check whether the torque command of terminal [Ai1]/[Ai2] is zero (0) under torque control mode.<br>➔ Modify the torque command to the appropriate value. |
| Under vector control with speed sensor<br>(21) Mismatch between the PG's pulse resolution and the function code setting. | Check whether the setting of function code P28, A30 or A130 matches the pulse resolution of the actual PG..<br>➔ Modify the data of P28, A30 or A130 to the appropriate value.<br>Check whether the voltage setting of terminal [PGP] (SW6) matches the voltage specification of the actual PG.<br>➔ Set SW6 to the appropriate position. |
| (22) The magnetic pole position of the permanent magnet synchronous motor (PMSM) is out of place. | Check the magnetic pole position.<br>➔ Adjust the magnetic pole position (o10, A60, A160).<br>(Refer to Chapter 4, Section 4.3.3 "Vector control for PMSM with speed sensor and magnetic pole position sensor," ■ Adjusting the magnetic pole position.") |

**[ 2 ] The motor rotates, but the speed does not change.**

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) The setting of the maximum speed was too low. | Check the data of function code F03, A06 or A106 (Maximum speed).<br>➔ Modify the data of F03, A06 or A106 to the appropriate value. |
| (2) The setting of the speed limiter was too low. | Check the setting of the speed limiter (F76 to F78).<br>➔ Modify the data of F76 to F78 to the appropriate value. |
| (3) The reference speed (analog setting) did not change. | Check whether the reference speed has been entered correctly, using Menu #4 "I/O CHECK" on the keypad.<br>➔ Increase the reference speed.<br>➔ Inspect the external speed command potentiometers, signal converters, switches, and relay contacts. Replace any ones that are faulty.<br>➔ Connect the external circuit wires to terminals [13], [12], [11], [Ai1] and [Ai2] correctly. |
| (4) The external circuit wiring to terminals [X1] to [X9] or signal assignment to those terminals is wrong. | Check whether the reference speed has been entered correctly, using Menu #4 "I/O CHECK" on the keypad.<br>➔ Connect the external circuit wires to terminals [X1] through [X9].<br>➔ Correct the data of E01 to E14.<br>➔ Correct the data of C05 to C21 (Multistep speed settings). |
| (5) A reference speed (e.g., multistep speed or via communications link) with higher priority than the one attempted was active and the reference speed was too low. | Referring to the speed command block diagram given in the FRENIC-VG User's Manual, Chapter 4, check the data of the relevant function codes and what speed commands are being received, using Menu #2 "DATA CHECK" and Menu #4 "I/O CHECK" with the keypad.<br>➔ Correct any incorrect data of function codes (e.g. cancel the higher priority reference speed). |
| (6) The acceleration or deceleration time was too long or too short. | Check the settings of the acceleration time and deceleration time (function codes F07, F08, C35, C36, C46, C47, C56, C57, C66 and C67).<br>➔ Change the acceleration/deceleration time to match the load. |
| (7) Overload. | Measure the output current.<br>➔ Reduce the load.<br>Check whether any mechanical brake is activated.<br>➔ Release the mechanical brake. |
| Under V/f control<br>(8) Function code settings do not agree with the motor characteristics. | If auto-torque boost (Function code P35, A55, A155) is enabled, check whether the data of P03, P04, P06, P07 and P08 for M1, A02, A03, A08, A09 and A10 for M2, A102, A103, A108, A109 and A110 for M3 matches the parameters of the motor.<br>➔ Perform auto-tuning of the inverter for the motor to be used. |

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| Under V/f control<br>(9) The output frequency does not increase due to the current limiter operation. | Decrease the value of the torque boost (Function code P35, A55, A155), then run the motor again and check if the speed increases.<br>➔ Adjust the value of the torque boost (P35, A55, A155).<br>Check the data of function codes F04, A05 and A105 to ensure that the V/f pattern setting is right.<br>➔ Match the V/f pattern setting with the motor ratings. |
| (10) The motor speed does not increase due to the torque limiter operation. | Check whether the data of torque limiter related function codes F40 through F45 is correctly configured and the ***TL2***/***TL1*** terminal command ("Select torque limiter level") is correct.<br>➔ Correct the data of F44 or F45 or enter the ***F40-CCL*** terminal command ("Cancel F40 (Torque limiter mode 1)"). |
| (11) Incorrect settings of bias and gain for analog input. | Check the data of function codes F17, F18 and E53 to E60.<br>➔ Correct the bias and gain settings. |
| (12) The reference speed did not change. (Keypad operation) | Check whether modifying the reference speed setting from the keypad changes the reference speed.<br>➔ Modify the reference speed setting by pressing the [↑] and [↓] keys. |
| Under vector control with speed sensor<br>(13) Wrong wiring of the PG. | Check the wiring between the PG and the inverter for the phase sequence, wire breaks, shielding and twisting.<br>➔ Correct the wiring. (Refer to Section 4.2.2 "Mounting direction of a pulse generator (PG) and PG signals.") |
| Under vector control with speed sensor<br>(14) Wrong wiring between the inverter and the motor. | Check the phase sequence (U, V, and W) of the main circuit wires between the inverter and the motor.<br>➔ Connect the inverter output terminals U, V, and W to the motor input terminals U, V, and W, respectively. |
| Under vector control with/without speed sensor<br>(15) Function code settings do not agree with the motor characteristics. | For exclusive motors for the FRENIC-VG: Check whether the data of function code P02 matches the specification of the connected motor.<br>➔ Correct the data of P02.<br>For other motors:<br>➔ Perform auto-tuning. |

### [ 3 ] The motor runs in the opposite direction to the command.

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| Under V/f control<br>Under vector control without speed sensor<br>(1) Wrong wiring to the motor. | Check the wiring to the motor.<br>➔ Connect the inverter output terminals U, V, and W to the motor input terminals U, V, and W, respectively. |
| (2) The rotation direction specification of the motor is opposite to that of the inverter. | The rotation direction of IEC-compliant motors is opposite to that of incompliant motors.<br>➔ Switch the ***FWD***/***REV*** signal setting. |
| (3) Incorrect setting of speed command related function code data. | Check the data of the speed command related function codes, referring to the speed command block diagram given in the FRENIC-VG User's Manual, Chapter 4.<br>➔ Correct the data of the related function codes. |
| Under vector control with speed sensor<br>(4) Wrong wiring of the PG. | Check the wiring to the motor.<br>➔ Correct the wiring. (Refer to Section 4.2.2 "Mounting direction of a pulse generator (PG) and PG signals.") |

### [ 4 ] Speed fluctuation or current oscillation (e.g., hunting) occurs during running at constant speed.

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) The analog speed command fluctuates. | Check the signal status for the speed command with Menu #4 "I/O CHECK" using the keypad. (Refer to Section 3.4.4.5.)<br>➔ Increase the filter constants (F83, E61 to E64) for the speed command.<br>➔ Take measures to keep the speed command constant. |

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (2) An external potentiometer is used for speed setting. | Check that there is no noise on the control signal wires connecting to external sources.<br>➔ Isolate the control signal wires from the main circuit wires as far as possible.<br>➔ Use shielded or twisted wires for control signals.<br>Check whether the external speed command potentiometer is malfunctioning due to noise from the inverter.<br>➔ Connect a capacitor to the output terminal of the potentiometer or set a ferrite core on the signal wire. (Refer to Chapter 2.) |
| (3) Speed switching or multistep speed command was enabled. | Check whether the relay signal for switching the speed command is chattering.<br>➔ If the relay contact is defective, replace the relay. |
| (4) The wiring length between the inverter and the motor is too long. | Check whether auto-torque boost is enabled (P35, A55, A155).<br>➔ Perform auto-tuning.<br>➔ Under V/f control, disable the automatic control system (select manual torque boost), then check that the motor vibration stops.<br>➔ Make the output wires as short as possible. |
| (5) The machinery is hunting due to vibration caused by low rigidity of the load. Or the current is irregularly oscillating due to special motor parameters. | Once disable all the automatic control systems (speed control, auto torque boost, current limiter, torque limiter and droop control), then check that the motor vibration comes to a stop.<br>➔ Under vector control with/without speed sensor, readjust the speed control system. (F61 through F66, C40 through C45, C50 through C55)<br>➔ Disable the automatic control system(s) causing the vibration. |
| (6) Function code settings do not agree with the motor characteristics. | For exclusive motors for the FRENIC-VG: Check whether the setting of function code P02 matches the specification of the connected motor.<br>➔ Correct the data of P02.<br>For other motors:<br>➔ Perform auto-tuning. |
| (7) Load is fluctuating. | Under vector control with/without speed sensor<br>Check whether automatic speed regulator (ASR) is properly configured. (F61 through F66, C40 through C45, C50 through C55)<br>➔ Readjust the ASR setting. |

**[ 5 ] Grating sound is heard from the motor or the motor sound fluctuates.**

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) The specified carrier frequency is too low. | Check the data of function code F26 (Motor sound (Carrier frequency)).<br>➔ Increase the data of F26. |
| (2) The surrounding temperature of the inverter was too high. | Measure the temperature inside the panel where the inverter is mounted.<br>➔ If it is over 40°C, lower it by improving the ventilation.<br>➔ Lower the temperature of the inverter by reducing the load. |
| (3) Resonance with the load. | Check the machinery mounting accuracy or check whether there is resonance with the mounting base.<br>➔ Disconnect the motor from the machinery and run it alone to find where the resonance comes from. Upon locating the cause, improve the characteristics of the source of the resonance.<br>➔ Adjust the jump speed (C01 through C04) to avoid continuous running in the frequency range causing resonance.<br>➔ Specify the observer (H47 through H52, H125 through H127) to suppress vibration. (Depending on the characteristics of the load, this may take no effect.)<br>➔ Decrease the P gain of the auto speed regulator (ASR). (F61, C40, C50, C60) |

**[ 6 ] The motor does not accelerate or decelerate within the specified time.**

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) The inverter runs the motor with S-curve acceleration/ deceleration. | Check the data of function codes F67 through F70 (S-curve acceleration/ deceleration pattern).<br>➔ Select the linear pattern (F67 through F70 = 0).<br>➔ Decrease the acceleration/deceleration time (F07, F08, C46, C47, C56, C57, C66, C67). |

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| Under V/f control<br>(2) The current limiting operation prevented the output frequency from increasing (during acceleration). | Check whether the acceleration time and torque boost are properly specified.<br>➔ Increase the data of F07, C35, C46, C56 or C66 (acceleration time).<br>➔ Decrease the torque boost (P35, A55, A155) and restart the inverter to check that the speed increases. |
| (3) Overload. | Measure the output current.<br>➔ Reduce the load. |
| Under V/f control<br>(4) Torque generated by the motor was insufficient. | Check that increasing the torque boost (P35, A55, A155) starts the motor.<br>➔ Increase the value of the torque boost (P35, A55, A155). |
| (5) An external potentiometer is used for speed setting. | Check that there is no noise on the control signal wires connecting to external sources.<br>➔ Isolate the control signal wires from the main circuit wires as far as possible.<br>➔ Use shielded or twisted wires for control signals.<br>Check whether the external speed command potentiometer is malfunctioning due to noise from the inverter.<br>➔ Connect a capacitor to the output terminal of the potentiometer or set a ferrite core on the signal wire. (Refer to Chapter 2, Section 2.3.9 "Detailed functions of control circuit terminals.") |
| (6) Motor torque generated is limited by the torque limiter. | Check whether data of torque limiter related function codes (F40 through F45) is correctly configured and the ***TL2***/***TL1*** terminal command ("Select torque limiter level 2/1") is correct.<br>➔ Correct the data of F40 through F45 or reset them to the factory defaults.<br>Check whether the speed command potentiometer is malfunctioning due to noise from the inverter.<br>➔ Set the ***TL2***/***TL1*** correctly.<br>➔ Increase the acceleration/deceleration time (F07, F08, C35, C36, C46, C47, C56, C57, C66, C67). |
| (7) The specified acceleration or deceleration time was incorrect. | Check the terminal commands ***RT1*** and ***RT2*** for acceleration/deceleration times.<br>➔ Correct the ***RT1*** and ***RT2*** settings. |

### [ 7 ] The motor does not restart even after the power recovers from a momentary power failure.

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) The data of function code F14 is either "0," "1," or "2." | Check if an undervoltage trip (*LU*) occurs.<br>➔ Change the data of F14 (Restart mode after momentary power failure, Mode selection) to "3," "4," or "5." |
| (2) The run command remains OFF even after the power has been restored. | Check the input signal with Menu #4 "I/O CHECK" using the keypad. (Refer to Section 3.4.4.5.)<br>➔ Check the power recovery sequence with an external circuit. If necessary, consider the use of a relay that can keep the run command ON. |
| | In 3-wire operation, the power to the control printed circuit board (control PCB) has been shut down once because of a long momentary power failure time, or the ***HOLD*** signal ("Enable 3-wire operation") has been turned OFF once.<br>➔ Change the design or the setting so that a run command can be issued again within 2 seconds after the power has been restored. |

### [ 8 ] The motor abnormally heats up.

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) Airflow volume of the motor's cooling fan decreased due to the service life expired or failure | Visually check whether the cooling fan rotates normally.<br>➔ Ask your Fuji Electric representative to repair the motor's cooling fan. |
| Under V/f control<br>(2) Excessive torque boost specified. | Check whether decreasing the torque boost (P35, A55, A155) decreases the output current but does not stall the motor.<br>➔ If no stall occurs, decrease the torque boost (P35, A55, A155). |

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| Under V/f control<br>(3) Continuous running in extremely slow speed. | Check the running speed of the inverter.<br>➔ Change the speed setting or replace the motor with an exclusive motor for inverters (motor with separately powered cooling fan). |
| (4) Overload. | Measure the inverter output current.<br>➔ Reduce the load.<br>➔ Increase the inverter capacity and motor capacity. |
| Under vector control with/without speed sensor<br>(5) Function code settings do not agree with the motor characteristics. | For exclusive motors for the FRENIC-VG: Check whether the setting of function code P02 matches the connected motor.<br>➔ Correct the data of P02.<br>For other motors:<br>➔ Perform auto-tuning. |
| (6) Motor defective. | Check whether the inverter output voltages (U, V and W) are well-balanced.<br>➔ Repair or replace the motor. |

**[ 9 ] The motor does not run as expected.**

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) Incorrect setting of function code data. | Check that function codes are correctly configured and no unnecessary configuration has been done.<br>➔ Configure all the function codes correctly. |
| | Make a note of function code data currently configured and then initialize all function code data using H03.<br>➔ After the above process, reconfigure function codes one by one, checking the running status of the motor. |
| (2) Under torque control, the inverter keeps output although the run command is OFF. | Check the setting of the automatic operation OFF function (H11).<br>➔ Set the data of H11 to "2" ("Coast to a stop when a run command is turned OFF") or "4" ("Coast to a stop when a run command is turned OFF" under torque control). |

**[ 10 ] When the motor accelerates or decelerates, the speed is not stable.**

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| Under vector control with/without speed sensor<br>(1) The control constants of the automatic speed regulator (ASR) are inadequate. | Check whether the automatic speed regulator (ASR) is properly adjusted under speed control.<br>➔ Readjust the ASR (F61 to F66, C40 to C45, C50 to C55). |

**[ 11 ] The motor stalls during acceleration.**

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| Under vector control with/without speed sensor<br>(1) Function code settings do not agree with the motor characteristics. | For exclusive motors for the FRENIC-VG: Check whether the setting of function code P02 matches the connected motor.<br>➔ Correct the data of P02.<br>For other motors:<br>➔ Perform auto-tuning. |
| Under V/f control<br>(2) The specified acceleration time is too short. | Check the data of F07, C35, C46, C56 or C66 (acceleration time).<br>➔ Increase the acceleration time. |
| Under V/f control<br>(3) The moment of inertia of the load is large. | Measure the inverter output current.<br>➔ Decrease the moment of inertia of the load.<br>➔ Increase the inverter capacity. |
| Under V/f control<br>(4) Large voltage drop on wires. | Check the terminal voltage of the motor.<br>➔ Use larger size wires between the inverter and motor or make the wiring distance shorter. |
| Under V/f control<br>(5) The torque of the load is large. | Measure the output current.<br>➔ Decrease the torque of the load.<br>➔ Increase the inverter capacity. |

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| Under V/f control<br>(6) Torque generated by the motor was insufficient. | Check that increasing the torque boost (P35, A55, A155) starts the motor.<br>➔ Increase the value of the torque boost (P35, A55, A155). |

**[ 12 ] When the T-Link communications option is in use, neither a run command nor a speed command takes effect.**

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) Incorrect setting of the communications link operation (H30). | Check whether the setting of the communications link operation is correct (H30).<br>➔ Correct the data of H30.<br>➔ Check the status of the X terminal to which the ***LE*** command ("Enable communications link") is assigned. |
| (2) Incorrect setting of the transmission format (o32). | Check whether the setting of the transmission format is correct (o32).<br>➔ Correct the data of o32 (4W + 4W or 8W + 8W). |
| (3) Incorrect setting of the link number. | Check the current setting of the link number (that should be configured in hexadecimal).<br>➔ Review the function code list. |
| (4) Data not written to the I/O relay area as assigned. | Check the data held in the I/O relay area, using the MICREX loader.<br>➔ Investigate writing into the I/O relay area. |

**[ 13 ] When the SX-bus communications option is in use, neither a run command nor a speed command takes effect.**

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) Incorrect setting of the communications link operation (H30). | Check whether the setting of the communications link operation is correct (H30).<br>➔ Correct the data of H30. |
| (2) Terminal command ***LE*** is assigned to an X terminal, but the terminal is OFF. | Check the status of the X terminal to which the ***LE*** command ("Enable communications link") is assigned.<br>➔ Turn the corresponding X terminal ON. |
| (3) Incorrect setting of the transmission format (U11). | Check whether the transmission format selected by U11 is identical with the one selected in the system configuration definition.<br>➔ Correct the setting of the transmission format. |
| (4) Incorrect setting of the link number. | Check the current setting of the link number (that should be configured in hexadecimal).<br>➔ Review the function code list. |
| (5) Data not written to the I/O relay area as assigned. | Check the data in application programs, using the SX loader.<br>➔ Investigate writing into the I/O memory area. |

**[ 14 ] When the CC-Link communications option is in use, neither a run command nor a speed command takes effect.**

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) Incorrect setting of the communications link operation (H30). | Check whether the setting of the communications link operation is correct (H30).<br>➔ Correct the data of H30. |
| (2) Terminal command ***LE*** is assigned to an X terminal, but the terminal is OFF. | Check the status of the X terminal to which the ***LE*** command ("Enable communications link") is assigned.<br>➔ Turn the corresponding X terminal ON. |
| (3) Incorrect setting of the transmission format (o32). | Check whether the transmission format selected by o32 is identical with the one selected in the system configuration definition.<br>➔ Correct the setting of the transmission format. |
| (4) Incorrect setting of the link number. | Check the current setting of the link number (that should be configured in hexadecimal).<br>➔ Review the function code list. |
| (5) Data not written to the I/O memory area as assigned. | Check the data in application programs, using the PLC loader.<br>➔ Investigate writing into the I/O memory area. |

**[ 15 ] _ _ _ _ (under bar) appears.**

Problem Although you pressed the FWD or REV key or entered a run forward command ***FWD*** or a run reverse command ***REV***, the motor did not start and an under bar ( _ _ _ _ ) appeared on the LED monitor.

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) The DC link bus voltage was low. | Select Menu #5 "MAINTENANCE" in Programming mode on the keypad and check the DC link bus voltage which should be 200 VDC or below for three-phase 200 V class series, and 400 VDC or below for three-phase 400 V class series. (Refer to Section 3.4.4.6.)<br>➔ Connect the inverter to a power supply that meets its input specifications. |
| (2) The main power is not ON, while the auxiliary input power to the control circuit is supplied. | Check whether the main power is turned ON.<br>➔ Turn the main power ON.<br>Check whether the short bar is removed from terminals P1 and P(+) or check the short bar for poor contact.<br>➔ Mount a short bar or DC reactor (DCR) between terminals P1 and P(+). Or tighten the fixing screw further. |
| (3) Although power is supplied not via the commercial power line but via the DC link bus, the main power down detection is enabled (H76 = 1). | Check the connection to the main power and check if the H76 data is set to "1" (factory default).<br>➔ Correct the data of H76. |
| (4) Breaks in wiring to the main power input terminals. | Measure the input voltage.<br>➔ Repair or replace the main circuit power input wires or input devices (MCCB, MC, etc.). |

### 6.5.2 Problems with inverter settings

**[ 1 ] Nothing appears on the monitors.**

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) No power (neither main power nor auxiliary control power) supplied to the inverter. | Check the input voltage and interphase voltage unbalance.<br>➔ Turn ON a molded case circuit breaker (MCCB), a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) or a magnetic contactor (MC).<br>➔ Check for voltage drop, phase loss, poor connections, or poor contacts and fix them if necessary. |
| (2) The power for the control PCB did not reach a sufficiently high level. | Check if the jumper bar has been removed from terminals P1 and P(+) or if there is a poor contact between the jumper bar and those terminals.<br>➔ Mount a jumper bar or a DC reactor between terminals P1 and P(+). For poor contact, tighten up the screws. |
| (3) The keypad was not properly connected to the inverter. | Check whether the keypad is properly connected to the inverter.<br>➔ Remove the keypad, put it back, and see whether the problem recurs.<br>➔ Replace the keypad with another one and check whether the problem recurs. |
| | When running the inverter remotely, ensure that the extension cable is securely connected both to the keypad and to the inverter.<br>➔ Disconnect the cable, reconnect it, and see whether the problem recurs.<br>➔ Replace the keypad with another one and check whether the problem per recurs. |

**[ 2 ] The desired function code does not appear.**

| Possible Causes | Check and Measures |
|---|---|
| (1) The function code is not located in the current directory. | Check whether the function code is located in a different directory.<br>➔ Display the function codes in the directory, referring to Chapter 3, Section 3.4 "Programming Mode."<br>If o codes do not appear, check whether an option board is mounted.<br>➔ Display the function codes in the directory, referring to Chapter 3, Section 3.4 "Programming Mode."<br>**Note:** No o codes appear unless an option board is mounted. |

**[ 3 ] Data of function codes cannot be changed from the keypad.**

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) An attempt was made to change function code data that cannot be changed when the inverter is running. | Check if the inverter is running with Menu #3 "OPR MNTR" using the keypad and then confirm whether the data of the function codes can be changed when the motor is running, referring to the function code tables.<br>➔ Stop the motor and then change the data of the function codes. |
| (2) The data of the function codes is protected. | Check the data of function code F00 (Data Protection).<br>➔ Change the data of F00 from "Enable data protection" (F00 = 1) to "Disable data protection" (F00 = 0). |
| (3) The ***WE-KP*** terminal command ("Enable data change with keypad") is not entered, though it has been assigned to a digital input terminal. | Check the data of function codes E01 through E09 and the input signal status with Menu #4 "I/O CHECK" using the keypad.<br>➔ Input a ***WE-KP*** command through a digital input terminal. |
| (4) The FUNC DATA key was not pressed. | Check whether you have pressed the FUNC DATA key after changing the function code data.<br>➔ Press the FUNC DATA key after changing the function code data.<br>➔ Check that "STORING…" is displayed on the LCD monitor. |
| (5) The data of function codes F02 and E01 through E09 cannot be changed. | Either one of the ***FWD*** and ***REV*** terminal commands is turned ON.<br>➔ Turn OFF both ***FWD*** and ***REV***. |

**[ 4 ] Data of function codes cannot be changed via the communications link.**

| Possible Causes | What to Check and Suggested Measures |
|---|---|
| (1) An attempt was made to change function code data that cannot be changed when the inverter is running. | Check if the inverter is running with Menu #3 "OPR MNTR" using the keypad and then confirm whether the data of the function codes can be changed when the motor is running, referring to the function code tables.<br>➔ Stop the motor and then change the data of the function codes. |
| (2) The data of the function codes is protected. | Check the data of function code F00 (Data Protection).<br>➔ Change the data of F00 from "Enable data protection" (F00 = 1) to "Disable data protection" (F00 = 0). |
| (3) The ***WE-LK*** terminal command ("Enable data change via communications link") is not entered, though it has been assigned to a digital input terminal. | Check the data of function codes E01 through E09 and the input signal status with Menu #4 "I/O CHECK" using the keypad.<br>➔ Input a ***WE-LK*** command through a digital input terminal. |
| (4) The "Full save function" (H02) was not executed. | Check that the "Full save function" was executed (H02 = 1).<br>➔ If data of function codes is changed via the communications link, execute the "Full save function"; otherwise, turning the power OFF loses the changed data. |
| (5) The data of function code F02 cannot be changed. | Either one of the ***FWD*** and ***REV*** terminal commands is turned ON.<br>➔ Turn OFF both ***FWD*** and ***REV***. |

# Chapter 7 MAINTENANCE AND INSPECTION

Perform daily and periodic inspections to avoid trouble and keep reliable operation of the inverter for a long time. When performing inspections, follow the instructions given in this chapter.

**⚠WARNING⚠**

- Before proceeding to the maintenance/inspection jobs, **turn OFF the power and wait at least five minutes for inverters with a capacity of 22 kW or below, or at least ten minutes for inverters with a capacity of 30 kW or above**. Make sure that the LED monitor and charging lamp are turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below).

  **Electric shock may occur.**
- Maintenance, inspection, and parts replacement should be made only by authorized persons.
- Take off the watch, rings and other metallic objects before starting work.
- Use insulated tools.
- Never modify the inverter.

  **Electric shock or injuries could occur.**

## 7.1 Inspection Interval

Table 7.1-1 lists the inspection intervals and check items, as a guide.

Table 7.1-1 List of Inspections

| Inspection type | Inspection interval | Check items |
|---|---|---|
| Daily inspection | Every day | See Section 7.2. |
| Periodic inspection | Every year | See Section 7.3. |
| Decennial inspection *1 | Every 10 years | Replacement of cooling fans *2<br>Replacement of DC link bus capacitors and close checks |

*1 The decennial inspection (except replacement of cooling fans) should be performed only by the persons who have finished the Fuji Electric training course. Contact the sales agent where you purchased the product or your nearest Fuji Electric representative.

*2 For the standard replacement interval of cooling fans, refer to Section 7.4 "List of Periodic Replacement Parts."

Note The replacement intervals are based on the inverter's service life estimated at a surrounding temperature of 40°C at 100% (HD-mode inverters) or 80% (MD/LD-mode inverters) of full load. In environments with a surrounding temperature above 40°C or a large amount of dust or dirt, the replacement intervals may be shorter.

Standard replacement intervals mentioned above are only a guide for replacement, not a guaranteed service life.

## 7.2 Daily Inspection

Visually inspect the inverter for operation errors from the outside without removing the covers when the inverter is running or the power is ON.

Table 7.2-1 lists daily inspection items.

Table 7.2-1 Daily Inspection List

| Check part | Check item | How to inspect | Evaluation criteria |
|---|---|---|---|
| Environment | 1) Check the surrounding temperature, humidity, vibration and atmosphere (dust, gas, oil mist, or water drops).<br>2) Check that tools or other foreign materials or dangerous objects are not left around the equipment. | 1) Check visually or measure using apparatus.<br>2) Visual inspection | 1) The installation environment given in Chapter 1, Section 1.3.1 must be satisfied.<br>2) No foreign or dangerous objects are left. |
| External appearance and others | 1) Check that the bolts securing the wires to the main circuit terminals and control circuit terminals are not loose before turning the power ON.<br>2) Check for traces of overheat, discoloration and other defects.<br>3) Check for abnormal noise, odor, or excessive vibration. | 1) Retighten.<br>2) Visual inspection<br>3) Auditory, visual, and olfactory inspection | 1) No looseness. If loose, retighten the screws.<br>2), 3) No abnormalities |
| Cooling fans | Check for abnormal noise or excessive vibration when the cooling fans are in operation. | Auditory and visual inspections | No abnormalities |
| Keypad | Check for alarm indication. | Visual inspection | If any alarm is displayed, refer to Chapter 6. |
| Performance | Check that the inverter provides the expected performance (as defined in the standard specifications). | Check the monitor items shown on the keypad. | No abnormalities in the output speed, current and voltage and other running data. |

## 7.3 Periodic Inspection

### [ 1 ] Periodic inspection 1--Before the inverter is powered ON or after it stops running

Perform periodic inspections according to the items listed in Table 7.3-1. Before performing periodic inspection 1, shut down the power and then remove the front cover.

Even if the power has been shut down, it takes the time for the DC link bus capacitor to discharge. After the charging lamp is turned OFF, therefore, make sure that the DC link bus voltage has dropped to the safe level (+25 VDC or below) using a multimeter or a similar instrument.

Table 7.3-1 Periodic Inspection List 1

| Check part | | Check item | How to inspect | Evaluation criteria |
|---|---|---|---|---|
| Structure such as frame and cover | | Check for:<br>1) Loose bolts (at clamp sections).<br>2) Deformation and breakage<br>3) Discoloration caused by overheat<br>4) Contamination and accumulation of dust or dirt | 1) Retighten.<br>2), 3), 4)<br>Visual inspection | 1), 2), 3), 4)<br>No abnormalities<br>(If any section is stained, clean it with a soft cloth.) |
| Main circuit | Common | 1) Check that bolts and screws are tight and not missing.<br>2) Check the devices and insulators for deformation, cracks, breakage and discoloration caused by overheat or deterioration.<br>3) Check for contamination or accumulation of dust or dirt. | 1) Retighten.<br>2), 3)<br>Visual inspection | 1), 2), 3)<br>No abnormalities<br>(If any section is stained, clean it with a soft cloth.) |
| | Conductors and wires | 1) Check conductors for discoloration and distortion caused by overheat.<br>2) Check the sheath of the wires for cracks and discoloration. | 1), 2)<br>Visual inspection | 1), 2)<br>No abnormalities |
| | Terminal blocks | Check that the terminal blocks are not damaged. | Visual inspection | No abnormalities |
| | DC link bus capacitor | 1) Check for electrolyte leakage, discoloration, cracks and swelling of the casing.<br>2) Check that the safety valve does not protrude remarkably.<br>3) Measure the capacitance if necessary. | 1), 2)<br>Visual inspection<br>3) Judgment on service life using "Menu #5 MAINTENANCE" in Section 3.4.4.6. | 1), 2)<br>No abnormalities<br>3) Capacitance ≥ Initial value x 0.85 |
| | Braking resistor | 1) Check for abnormal odor or cracks in insulators caused by overheat.<br>2) Check for wire breakage. | 1) Olfactory and visual inspection<br>2) Check the wires visually, or disconnect either one wire and measure the conductivity with a multimeter. | 1) No abnormalities<br>2) Within ±10% of the resistance of the braking resistor |
| Control circuit | Printed circuit board | 1) Check for loose screws and connectors.<br>2) Check for odor and discoloration.<br>3) Check for cracks, breakage, deformation and remarkable rust.<br>4) Check the capacitors for electrolyte leaks and deformation. | 1) Retighten.<br>2) Olfactory and visual inspection<br>3), 4)<br>Visual inspection<br>* Judgment on service life using "Menu #5 MAINTENANCE" in Section 3.4.4.6. | 1), 2), 3), 4)<br>No abnormalities |
| Cooling system | Cooling fan | 1) Check for any abnormality.<br>2) Check for loose bolts.<br>3) Check for discoloration caused by overheat. | 1) Turn by hand. (Be sure to turn the power OFF beforehand.)<br>2) Retighten.<br>3) Visual inspection<br>* Judgment on service life using "Menu #5 MAINTENANCE" in Section 3.4.4.6. | 1) Smooth rotation<br>2), 3)<br>No abnormalities |
| | Ventilation path | Check the heat sink, intake and exhaust ports for clogging and foreign materials. | Visual inspection | No clogging or accumulation of dust, dirt or foreign materials.<br>Clean it, if any, with a vacuum cleaner. |

### [ 2 ] Periodical inspection 2--When the inverter is ON or it is running

Visually inspect the inverter for operation errors from the outside without removing the covers when the inverter is ON or it is running.

Perform periodic inspections according to the items listed in Table 7.3-2

Table 7.3-2 Periodic Inspection List 2

| Check part | | Check item | How to inspect | Evaluation criteria |
|---|---|---|---|---|
| Input voltage | | Check that the input voltages of the main and control circuits are correct. | Measure the input voltages using a multimeter or the like. | The standard specifications must be satisfied. |
| Structure such as chassis and covers | | Check for abnormal noise or excessive vibration when the inverter is running. | Visual and auditory inspections | No abnormalities |
| Main circuit | Transformers and reactors | Check for abnormal roaring noise or odor when the inverter is running. | Auditory, visual, and olfactory inspections | No abnormalities |
| | Magnetic contactors and relays | Check for chatters when the inverter is running. | Auditory inspection | No abnormalities |

**Additional notes**

(1) The inspection interval (every year) of check items given in Table 7.3-1 and Table 7.3-2 is merely a guide. Make the interval shorter depending on the installation environment.

(2) Store and organize the inspection results to utilize them as a guide for operation and maintenance of the equipment and service life estimation.

(3) At the time of an inspection, check the cumulative run times on the keypad to utilize them as a guide for replacement of parts. (Refer to Section 7.4.1 "Judgment on service life.")

(4) The inverter has cooling fans inside to ventilate itself for discharging the heat generated by the power converter section. This will accumulate dust or dirt on the heat sink depending on the surrounding environment.

In a dusty environment, the heat sink requires cleaning in a shorter interval than that specified in periodic inspection. Neglecting cleaning of the heat sink can rise its temperature, activating protective circuits to lead to an abrupt shutdown or causing the temperature rise of the surrounding electronic devices to adversely affect their service life.

### [ 3 ] Checking the functional safety circuit

In applications where no regular activation of the Safe Torque Off (STO) function with terminals [EN1] and [EN2] is guaranteed, check at least once a year that the Safe Torque Off (STO) function works correctly.

## 7.4 List of Periodic Replacement Parts

Each part of the inverter has its own service life that will vary according to the environmental and operating conditions. It is recommended that the following parts be replaced at the specified intervals.

When the replacement is necessary, consult your Fuji Electric representative.

Table 7.4-1 Replacement Parts

| Part name | Standard replacement intervals (See **Note** below.) |
|---|---|
| DC link bus capacitor | 10 years |
| Electrolytic capacitors on printed circuit boards | 10 years |
| Cooling fans | 10 years |
| Fuses | 10 years |
| Battery | 5 years (Battery surrounding temperature 60°C, Inverter not powered) |

**Note** These replacement intervals are based on the inverter's service life estimated at a surrounding temperature of 40°C at 100% (HD-mode inverters) or 80% (MD/LD-mode inverters) of full load. In environments with a surrounding temperature above 40°C or a large amount of dust or dirt, the replacement intervals may be shorter.

**Notes for periodic replacement of parts**

(1) The replacement intervals listed above are a guide for almost preventing parts from failure if those parts are replaced with new ones at the intervals. They do not guarantee the completely fault-free operation.

(2) The table above does not apply to unused spare parts being kept in storage. It applies only when they are stored in a well-ventilated, cool and dark place and energized approximately once a year.

(3) Cooling fans and battery can be replaced by users. As for other parts, only the persons who have finished the Fuji Electric training course can replace them. For the purchase of spare cooling fans and battery and the request for replacement of other parts, contact the sales agent where you purchased the product or your nearest Fuji Electric representative.

### 7.4.1 Judgment on service life

The inverter has the life prediction function for some parts which measures the discharging time or counts the voltage applied time, etc. The function allows you to monitor the current lifetime state on the LED monitor and judge whether those parts are approaching the end of their service life.

The life prediction function can also issue early warning signals if the life time alarm command ***LIFE*** is assigned to any of the digital output terminals. (Refer to Section 3.4.4.6 "Reading maintenance information -- Menu #5 "MAINTENANCE".")

Table 7.4-2 lists the parts whose service life can be predicted and details the life prediction function. The predicted values should be used only as a guide since the actual service life is influenced by the surrounding temperature and other usage environments.

Table 7.4-2 Life Prediction

| Object of life prediction | Prediction function | End-of-life criteria | Prediction timing | "5: MAINTENANCE" on the LCD monitor |
|---|---|---|---|---|
| DC link bus capacitor | Measurement of discharging time<br>Measures the discharging time of the DC link bus capacitor when the main power is shut down and calculates the capacitance. | 85% or lower of the initial capacitance at shipment | At periodic inspection<br>(H104: Bit 0 = 0) | LCD page 2<br>CAP (Capacity) |
| | | 85% or lower of the reference capacitance under ordinary operating conditions at the user site | During ordinary operation<br>(H104: Bit 0 = 1) | LCD page 2<br>CAP (Capacity) |
| | ON-time counting<br>Counts the time elapsed when the voltage is applied to the DC link bus capacitor, while correcting it according to the capacitance measured above. | Exceeding 87,600 hours (10 years) | During ordinary operation | LCD page 8<br>CAPEH (Elapsed time)<br>CAPRH (Time remaining before the end of life) |
| Electrolytic capacitors on printed circuit boards | Counts the time elapsed when the voltage is applied to the capacitors, while correcting it according to the surrounding temperature. | Exceeding 87,600 hours (10 years) | During ordinary operation | LCD page 3<br>TCAP (Cumulative run time) |
| Cooling fans | Counts the run time of the cooling fans. | Exceeding 87,600 hours (10 years) | During ordinary operation | LCD page 3<br>TFAN (Cumulative run time) |

The service life of the DC link bus capacitor can be judged by the "measurement of discharging time" or "ON-time counting."

### [ 1 ] Measurement of discharging time of the DC link bus capacitor

- The discharging time of the DC link bus capacitor depends largely on the inverter's internal load conditions, e.g. options attached or ON/OFF of digital I/O signals. If actual load conditions are so different from the ones at which the initial/reference capacitance is measured that the measurement result falls out of the accuracy level required, then the inverter does not perform measuring.
- The capacitance measuring conditions at shipment are drastically restricted, e.g., all input terminals being OFF in order to stabilize the load and measure the capacitance accurately. Those conditions are, therefore, different from the actual operating conditions in almost all cases. If the actual operating conditions are the same as those at shipment, shutting down the inverter power automatically measures the discharging time; however, if they are different, no automatic measurement is performed. To perform it, put those conditions back to the factory default ones and shut down the inverter. Refer to the measuring procedure given below.
- To measure the capacitance of the DC link bus capacitor *under ordinary operating conditions* when the power is turned OFF, it is necessary to set up the load conditions for ordinary operation and measure the reference capacitance (initial setting) when the inverter is introduced. For the reference capacitance setup procedure, see (2) on the next page. Performing the setup procedure automatically detects and saves the measuring conditions of the DC link bus capacitor.

  Setting bit 0 of H104 data at "0" restores the inverter to the measurement in comparison with the initial capacitance measured at shipment.

Note When the inverter uses an auxiliary control power input, the load conditions widely differ so that the discharging time cannot be accurately measured. In this case, measuring of the discharging time can be disabled with the function code H104 (Bit 0 = 0) for preventing unintended measuring.

### [ 2 ] ON-time counting of DC link bus capacitor

- In a machine system where the inverter main power is rarely shut down, the inverter does not measure the discharging time. For such an inverter, the ON-time counting is provided. The ON-time counting result can be represented as "elapsed time"(CAPEH) and "time remaining before the end of life" (CAPRH) as shown in Table 7.4-2, "5: MAINTENANCE on the LCD monitor" column.

#### (1) Measuring the capacitance of DC link bus capacitor in comparison with initial one at shipment

The measuring procedure given below measures the capacitance of DC link bus capacitor in comparison with initial one at shipment when the power is turned OFF. The measuring result can be displayed on the keypad as a ratio (%) to the initial capacitance.

---------- **Capacitance measuring procedure** ----------

1) To ensure validity in the comparative measurement, put the condition of the inverter back to the state at factory shipment.
   - Remove the option card (if already in use) from the inverter.
   - In case another inverter is connected via the DC link bus to the P(+) and N(-) terminals of the main circuit, disconnect the wires. (You do not need to disconnect a DC reactor (optional), if any.)
   - Disconnect power wires for the auxiliary input to the control circuit (R0, T0).
   - Mount the keypad.
   - Turn OFF all the digital input signals fed to terminals [FWD], [REV], and [X1] through [X9] of the control circuit.
   - If an external speed command potentiometer is connected to terminal [13], disconnect it.
   - If an external apparatus is attached to terminal [PLC], disconnect it.
   - Ensure that transistor output signals ([Y1] to [Y4]) and Relay output terminals ([Y5A],[Y5C]) will not be turned ON.
   - Disable the RS-485 communications link.

     Note If negative logic is specified for the transistor output and relay output signals, they are considered ON when the inverter is not running. Specify positive logic for them.

   - Keep the surrounding temperature within 25 ±10°C.
2) Turn ON the main circuit power.
3) Confirm that the cooling fan is rotating and the inverter is in stopped state.
4) Turn OFF the main circuit power.
5) The inverter automatically starts the measurement of the capacitance of the DC link bus capacitor. Make sure that " . . . . " appears on the LED monitor.

   Note If " . . . . " does not appear on the LED monitor, the measurement has not started. Check the conditions listed in 1).

6) After " . . . . " has disappeared from the LED monitor, turn ON the main circuit power again.
7) Select Menu #5 "MAINTENANCE" in Programming mode and check the main capacitor capacity % (CAP).

---

**(2) Measuring the capacitance of the DC link bus capacitor under ordinary operating conditions**

The inverter automatically measures the capacitance of the DC link bus capacitor under ordinary operating conditions when the power is turned OFF. This measurement requires setting up the load conditions for ordinary operation and measuring the reference capacitance when the inverter is introduced to the practical operation, using the setup procedure given below

---------- **Reference capacitance setup procedure** ----------

1) Set bit 0 of function code H104 at "1" (User mode) to enable the user to specify the judgment criteria for the service life of the DC link bus capacitor (Bit 0 = 1) (refer to function code H104).
2) Turn OFF all run commands.
3) Make the inverter ready to be turned OFF under ordinary operating conditions.
4) Set function code H80 (Capacitance of DC Link Bus Capacitor) at "1."
5) Turn OFF the inverter, and the following operations are automatically performed.

   The inverter measures the discharging time of the DC link bus capacitor and saves the result in function code H80 (Capacitance of DC Link Bus Capacitor).

   The conditions under which the measurement has been conducted will be automatically collected and saved.
6) Turn ON the inverter again.

   Confirm that H80 (Capacitance of DC Link Bus Capacitor) holds right values. Shift to Menu #5 "MAINTENANCE" and confirm that the main capacitor capacity is 100% (CAP = 100%).

   Note If the measurement has failed, "1" is entered into H80. Remove the factor of the failure and conduct the measurement again.

---

Hereafter, each time the inverter is turned OFF, it automatically measures the discharging time of the DC link bus capacitor if the above conditions are met. Periodically check the relative capacitance of the DC link bus capacitor (%) with Menu #5 "MAINTENANCE" in Programming mode.

Note The condition given above produces a rather large measurement error. If this mode gives you a lifetime alarm, set H104 back to the default setting (Bit 0 = 0) and conduct the measurement under the condition at the time of factory shipment.

**(3) Early warning of lifetime alarm**

For the components listed in Table 7.4-2, the inverter can issue an early warning of lifetime alarm ***LIFE*** at one of the transistor output terminals ([Y1] to [Y4]) and Relay output terminals ([Y5A],[Y5C]) as soon as any of the levels specified in Table 7.4-2 has been exceeded.

The early warning signal is also turned ON when a lock condition on the internal air circulation DC fan (provided on 200 V class series inverters with a capacity of 45 kW or above; on 400 V class series inverters with a capacity of 75 kW or above) has been detected.

### 7.4.2 Battery

#### [ 1 ] Outline

The battery is used to back up the traceback memory and the calendar clock when no power is applied to the inverter. It is provided as an option for inverters of up to 22 kW, and as standard for those of 30 kW or above.

| | |
|---|---|
| Model | OPK-BP |
| Battery voltage/capacity | 3.6 V/1100 mAh |
| Type | Lithium-thionyl chloride battery |
| Replacement interval (as a guide) | 5 years (Battery surrounding temperature 60°C, Inverter not powered) |

Unit: mm

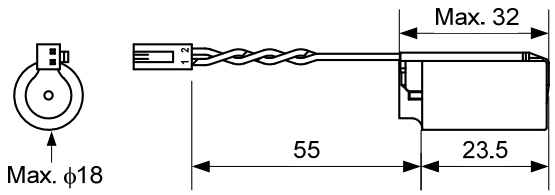



Figure 7.4-1 Outside View and Dimensions

## ⚠WARNING

**Safety Precautions**

The lithium thionyl chloride battery, which contains lithium (dangerous material) and thionyl chloride (deleterious material), is a hermetically sealed, high-energy density battery. Improper use of the battery could cause deformation, leakage of battery fluid (Liquid inside the battery leaks out), heat generation, battery-rupture or fire, or produce irritant and corrosive gas. This could result in bodily injury or inverter fault. Be sure to observe the following precautions.

- Take care not to swallow the battery.
- Do not apply excessive force to the positive terminal of the battery.
- Do not drop the battery.
- Do not short-circuit the battery terminals.
- Do not charge the battery.
- Do not discharge the battery forcedly.
- Never heat the battery.
- Never put the battery into fire.
- Never disassemble the battery.
- Do not deform the battery by pressure.
- When loading the battery into the inverter, take care not to insert it in wrong direction.
- Do not touch the fluid leaked from the battery.
- Do not leave a damaged battery in the inverter.

## ⚠CAUTION

When storing the battery, keep it away from direct sunlight, high temperature, high humidity, and rainwater.

The battery used in this product is a so-called primary battery. When disposing of it, comply with local codes and regulations.

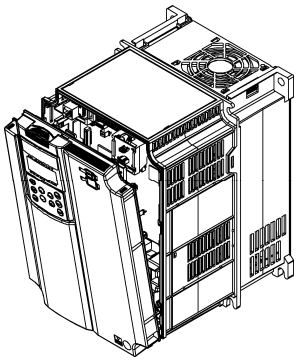
**[ 2 ] Loading the battery**

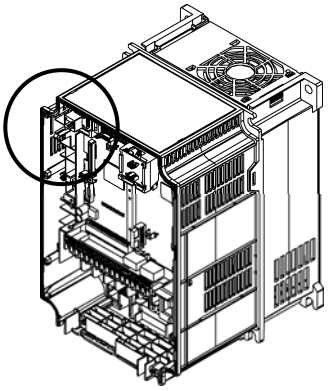
| ⚠CAUTION |
| --- |
| Before proceeding to the loading procedure, be sure to shut down the power.<br>**Fire or an accident could occur.** |

* For the calendar clock setting, refer to Section 3.2.1 "Setting the calendar clock."

**(1) Battery loading procedure for inverters of 22 kW or below**

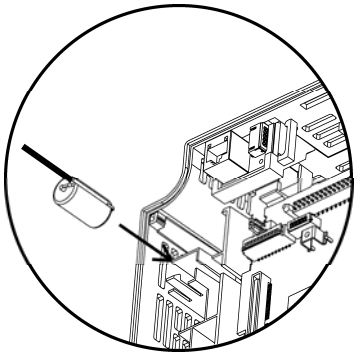
1) Remove the front cover.

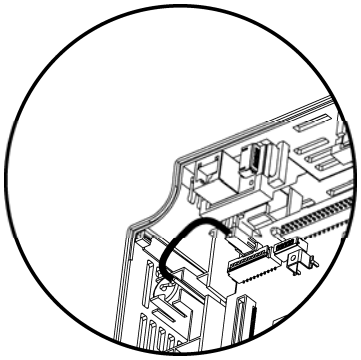




2) Load the battery to the location shown below.

3) Fully insert the battery connector into the connector CN7 on the control printed circuit board.





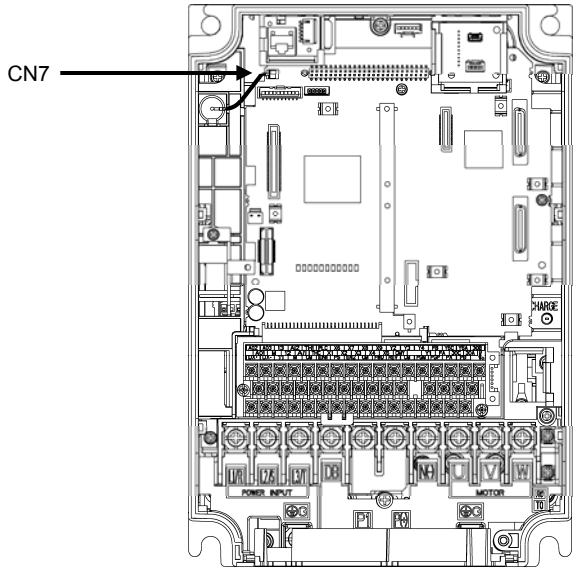
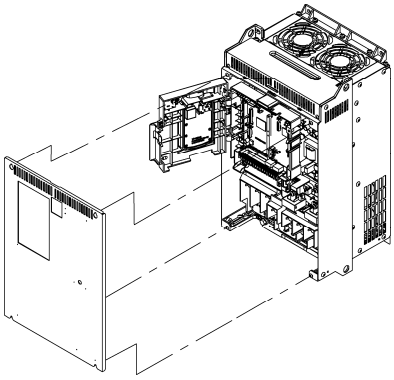


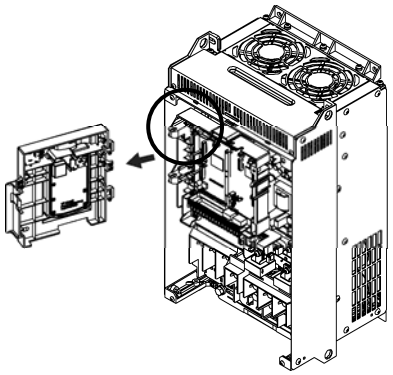

Figure 7.4-2 Battery Loaded (22 kW or below)

**(2) Battery loading procedure for inverters of 30 kW or above**

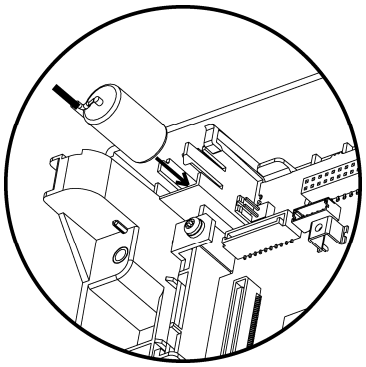
1) Remove the front cover.
Open the keypad and disconnect it from connectors CN5 and CN8 on the control printed circuit board.



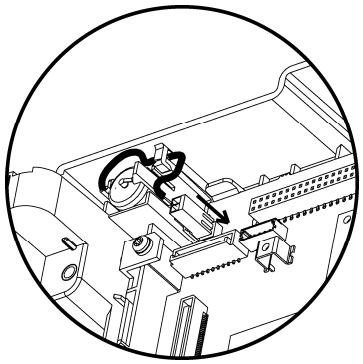
2) Remove the keypad.



3) Load the battery to the location shown below.



4) Fully insert the battery connector into the connector CN7 on the control printed circuit board.



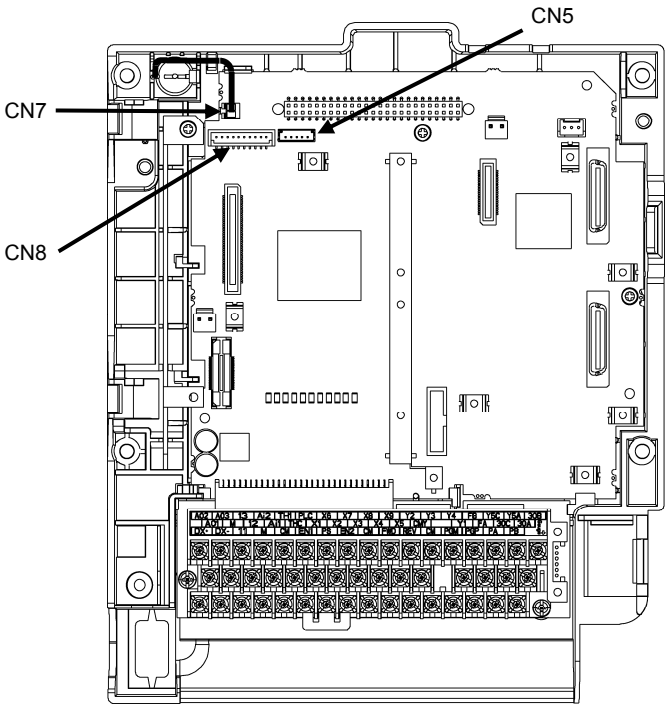



Figure 7.4-3 Battery Loaded (30 kW or above)

**(3) Battery replacement procedure**

Remove the battery from the inverter in the reverse order of loading and then load a new battery.

| ⚠CAUTION |
| --- |
| Before proceeding to the loading procedure, be sure to shut down the power.<br>**Fire or an accident could occur.** |

* For the calendar clock setting, refer to Section 3.2.1 "Setting the calendar clock."

### [ 3 ] About marine or air transport of a lithium-metal battery

When transporting a lithium-metal battery by itself, by packing it in a package of the inverter, or by incorporating it in the inverter, observe the following notes.

(1) To transport a lithium-metal battery incorporated in the inverter

When transporting a panel holding five or more inverters with a built-in battery, it is necessary to attach the label shown in Figure 7.4-4 and prepare the transportation documents.

(2) To transport a lithium-metal battery packed with the inverter

It is necessary to attach the label shown in Figure 7.4-4 and issue a drop test certificate together with the transportation documents.

To transport a lithium-metal battery by air, the number of batteries that can be contained in a package of the inverter is limited to the number of batteries required for device operation plus 2 batteries.

120 x 110 mm

Figure 7.4-4 Label to be Attached to Outer Wrapping

For details, contact your shipping company.

## 7.5 Measurement of Electrical Amounts in Main Circuit

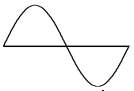
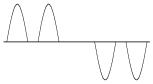
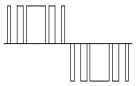
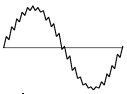
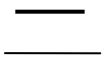
Because the voltage and current of the power supply (input, primary circuit) of the main circuit of the inverter and those of the motor (output, secondary circuit) contain harmonic components, the readings may vary with the type of the meter. Use meters indicated in Table 7.5-1 when measuring with meters for commercial frequencies.

The power factor cannot be measured by a commercially available power-factor meter that measures the phase difference between the voltage and current. To obtain the power factor, measure the power, voltage and current on each of the input and output sides and use the following formula.

■ Three-phase input

$$\text{Power factor} = \frac{\text{Electric power (W)}}{\sqrt{3} \times \text{Voltage (V)} \times \text{Current (A)}} \times 100\,\%$$

Table 7.5-1 Meters for Measurement of Main Circuit

| Item | Input (primary) side | | | Output (secondary) side | | | DC link bus voltage (P(+)-N(-)) |
|---|---|---|---|---|---|---|---|
| Waveform | Voltage  Current  | | | Voltage  Current  | | |  |
| Name of meter | Ammeter AR, AS, AT | Voltmeter VR, VS, VT | Wattmeter WR, WT | Ammeter AU, AV, AW | Voltmeter VU, VV, VW | Wattmeter WU, WW | DC voltmeter V |
| Type of meter | Moving iron type | Rectifier or moving iron type | Digital AC power meter | Digital AC power meter | Digital AC power meter | Digital AC power meter | Moving coil type |
| Symbol of meter | | | — | — | — | — | |

Note It is not recommended that meters other than a digital AC power meter be used for measuring the output voltage or output current since they may cause larger measurement errors or, in the worst case, they may be damaged.

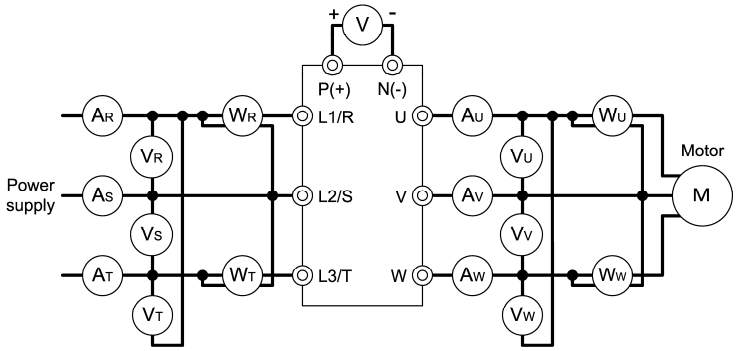



Figure 7.5-1 Connection of Meters

## 7.6 Insulation Test

Since the inverter has undergone an insulation test before shipment, avoid making a Megger test at the customer's site.

If a Megger test is unavoidable for the main circuit, observe the following instructions; otherwise, the inverter may be damaged.

A withstand voltage test may also damage the inverter if the test procedure is wrong. When the withstand voltage test is necessary, consult your Fuji Electric representative.

### (1) Megger test of main circuit

1) Use a 500 VDC Megger and shut off the main power supply without fail before measurement.
2) If the test voltage leaks to the control circuit due to the wiring, disconnect all the wiring from the control circuit.
3) Connect the main circuit terminals with a common line as shown in Figure 7.6-1.
4) The Megger test must be limited to across the common line of the main circuit and the ground (⏚).
5) Value of 5 MΩ or more displayed on the Megger indicates a correct state. (The value is measured on an inverter alone.)

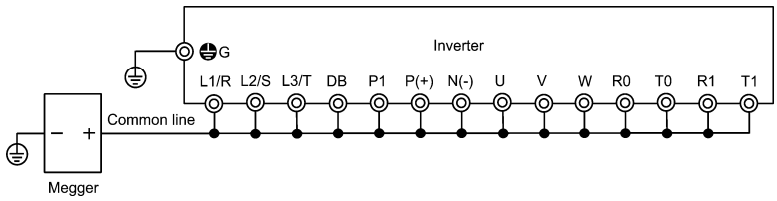



Figure 7.6-1 Main Circuit Terminal Connection for Megger Test

### (2) Insulation test of control circuit

Do not make a Megger test or withstand voltage test for the control circuit. Use a high resistance range tester for the control circuit.

1) Disconnect all the external wiring from the control circuit terminals.
2) Perform a continuity test to the ground. One MΩ or a larger measurement indicates a correct state.

### (3) Insulation test of external main circuit and sequence control circuit

Disconnect all the wiring connected to the inverter so that the test voltage is not applied to the inverter.

## 7.7 Inquiries about Product and Guarantee

### 7.7.1 When making an inquiry

Upon breakage of the product, uncertainties, failure or inquiries, inform your Fuji Electric representative of the following information.

1) Inverter type (Refer to Chapter 1, Section 1.1.)
2) SER No. (serial number of equipment) (Refer to Chapter 1, Section 1.1.)
3) Function codes and their data that you changed (refer to the FRENIC-VG User's Manual Chapter 3, Section 3.4.4.3.)
4) ROM version (refer to the FRENIC-VG User's Manual Chapter 3, Section 3.4.4.6.)
5) Date of purchase
6) Inquiries (for example, point and extent of breakage, uncertainties, failure phenomena, and other circumstances)

### 7.7.2 Product warranty

**To all our customers who purchase Fuji Electric products included in this documentation:**

Please take the following items into consideration when placing your order.

When requesting an estimate and placing your orders for the products included in these materials, please be aware that any items such as specifications which are not specifically mentioned in the contract, catalog, specifications or other materials will be as mentioned below.

In addition, the products included in these materials are limited in the use they are put to and the place where they can be used, etc., and may require periodic inspection. Please confirm these points with your sales representative or directly with this company.

Furthermore, regarding purchased products and delivered products, we request that you take adequate consideration of the necessity of rapid receiving inspections and of product management and maintenance even before receiving your products.

#### [ 1 ] Free of charge warranty period and warranty range

(1) Free of charge warranty period

1) The product warranty period is "1 year from the date of purchase" or 18 months from the manufacturing week imprinted on the name place, whichever date is earlier.
2) However, in cases where the use environment, conditions of use, use frequency and times used, etc., have an effect on product life, this warranty period may not apply.
3) Furthermore, the warranty period for parts restored by Fuji Electric's Service Department is "6 months from the date that repairs are completed."

(2) Warranty range

1) In the event that breakdown occurs during the product's warranty period which is the responsibility of Fuji Electric, Fuji Electric will replace or repair the part of the product that has broken down free of charge at the place where the product was purchased or where it was delivered. However, if the following cases are applicable, the terms of this warranty may not apply.
   ① The breakdown was caused by inappropriate conditions, environment, handling or use methods, etc. which are not specified in the catalog, operation manual, specifications or other relevant documents.
   ② The breakdown was caused by the product other than the purchased or delivered Fuji's product.
   ③ The breakdown was caused by the product other than Fuji's product, such as the customer's equipment or software design, etc.
   ④ Concerning the Fuji's programmable products, the breakdown was caused by a program other than a program supplied by this company, or the results from using such a program.
   ⑤ The breakdown was caused by modifications or repairs affected by a party other than Fuji Electric.
   ⑥ The breakdown was caused by improper maintenance or replacement using consumables, etc. specified in the operation manual or catalog, etc.
   ⑦ The breakdown was caused by a science or technical problem that was not foreseen when making practical application of the product at the time it was purchased or delivered.
   ⑧ The product was not used in the manner the product was originally intended to be used.
   ⑨ The breakdown was caused by a reason which is not this company's responsibility, such as lightning or other disaster.
2) Furthermore, the warranty specified herein shall be limited to the purchased or delivered product alone.
3) The upper limit for the warranty range shall be as specified in item (1) above and any damages (damage to or loss of machinery or equipment, or lost profits from the same, etc.) consequent to or resulting from breakdown of the purchased or delivered product shall be excluded from coverage by this warranty.

(3) Trouble diagnosis

As a rule, the customer is requested to carry out a preliminary trouble diagnosis. However, at the customer's request, this company or its service network can perform the trouble diagnosis on a chargeable basis. In this case, the customer is asked to assume the burden for charges levied in accordance with this company's fee schedule.

### [ 2 ] Exclusion of liability for loss of opportunity, etc.

Regardless of whether a breakdown occurs during or after the free of charge warranty period, this company shall not be liable for any loss of opportunity, loss of profits, or damages arising from special circumstances, secondary damages, accident compensation to another company, or damages to products other than this company's products, whether foreseen or not by this company, which this company is not be responsible for causing.

### [ 3 ] Repair period after production stop, spare parts supply period (holding period)

Concerning models (products) which have gone out of production, this company will perform repairs for a period of 7 years after production stop, counting from the month and year when the production stop occurs. In addition, we will continue to supply the spare parts required for repairs for a period of 7 years, counting from the month and year when the production stop occurs. However, if it is estimated that the life cycle of certain electronic and other parts is short and it will be difficult to procure or produce those parts, there may be cases where it is difficult to provide repairs or supply spare parts even within this 7-year period. For details, please confirm at our company's business office or our service office.

### [ 4 ] Transfer rights

In the case of standard products which do not include settings or adjustments in an application program, the products shall be transported to and transferred to the customer and this company shall not be responsible for local adjustments or trial operation.

### [ 5 ] Service contents

The cost of purchased and delivered products does not include the cost of dispatching engineers or service costs. Depending on the request, these can be discussed separately.

### [ 6 ] Applicable scope of service

Above contents shall be assumed to apply to transactions and use of the country where you purchased the products.

Consult the local supplier or Fuji for the detail separately.

# Chapter 8 CONFORMITY WITH STANDARDS

## 8.1 Compliance with European Standards ( CE )

The CE marking on Fuji products indicates that they comply with the essential requirements of the Electromagnetic Compatibility (EMC) Directive 2004/108/EC, Low Voltage Directive 2006/95/EC, and Machinery Directive 2006/42/EC which are issued by the Council of the European Communities.

Table 8.1-1 Conformity with Standards

| | Standards |
|---|---|
| EMC Directives | IEC/EN61800-3: 2004<br>Immunity: Second environment (Industrial)<br>Emission: 220 kW or below: Category C2<br>280 kW or above: Category C3<br>IEC/EN61326-3-1: 2008 |
| Low Voltage Directive | IEC/EN61800-5-1: 2007 |
| Machinery Directive | EN ISO13849-1: 2008 PL-d, Category 3<br>IEC/EN 60204-1: 2009 Stop category 0 |
| Functional Safety Standard | IEC/EN 61800-5-2: 2007 SIL2<br>IEC/EN 62061: 2010 SIL2 |

### 8.1.1 Compliance with EMC standards

The CE marking on inverters does not ensure that the entire equipment including our CE-marked products is compliant with the EMC Directive. Therefore, CE marking for the equipment shall be the responsibility of the equipment manufacturer. For this reason, Fuji's CE mark is indicated under the condition that the product shall be used within equipment meeting all requirements for the relevant Directives. Instrumentation of such equipment shall be the responsibility of the equipment manufacturer.

Generally, machinery or equipment includes not only our products but other devices as well. Manufacturers, therefore, shall design the whole system to be compliant with the relevant Directives.

**■ List of EMC-compliant filters**

To satisfy the requirements noted above, use inverters in combination with an external filter (option) dedicated to Fuji inverters. In either case, mount inverters in accordance with the installation procedure given below. To ensure the compliance, it is recommended that inverters be mounted in a metal panel.

| Power supply voltage | Inverter type | | Filter type | Remarks |
|---|---|---|---|---|
| Three-phase 200V | FRN0.75VG1□-2□** | HD | EFL-7.5SP-2 | |
| | FRN1.5VG1□-2□** | HD | | |
| | FRN2.2VG1□-2□** | HD | | |
| | FRN3.7VG1□-2□** | HD | | |
| | FRN5.5VG1□-2□** | HD | | |
| | FRN7.5VG1□-2□** | HD | | |
| | FRN11VG1□2□** | HD | EFL-15SP-2 | |
| | FRN15VG1□-2□** | HD | | |
| | FRN18.5VG1□-2□** | HD | | |
| | FRN22VG1□-2□** | HD | EFL-22SP-2 | In addition to a filter option, two zero-phase reactors ACL-74B (Number of pass-throughs: 2) are required at the power supply side. (See Figure 8.1-1.) |
| | FRN30VG1□-2□** | HD | FS5536-180-40 | |
| | | LD | FS5536-250-99-1 | |
| | FRN37VG1□-2□** | HD | | |
| | | LD | | |
| | FRN45VG1□-2□** | HD | | |
| | | LD | FS5536-400-99-1 | |
| | FRN55VG1□-2□** | HD | | |
| | | LD | | |
| | FRN75VG1□-2□** | HD | | |
| | | LD | | |
| | FRN90VG1□-2□** | HD | | |
| | | LD | FN3359-600-99 | |

**Note:** A box (□) replaces an alphabetic letter depending on the enclosure or the shipping destination. Refer to Chapter 1, Section 1.1.

| Power supply voltage | Inverter type | | Filter type | Remarks |
|---|---|---|---|---|
| Three-phase 400V | FRN3.7VG1□-4□** | HD | FS24278-35-47 | |
| | FRN5.5VG1□-4□** | HD | | |
| | FRN7.5VG1□-4□** | HD | | |
| | FRN11VG1□-4□** | HD | FS5536-50-07 (EFL-15G11-4) | |
| | FRN15VG1□-4□** | HD | | |
| | FRN18.5VG1□-4□** | HD | FS5536-72-07 (EFL-22G11-4) | |
| | FRN22VG1□-4□** | HD | | |
| | FRN30VG1□-4□** | HD | FS5536-100-35 | |
| | | LD | | |
| | FRN37VG1□-4□** | HD | | |
| | | LD | FS5536-180-40 | |
| | FRN45VG1□-4□** | HD | | |
| | | LD | | |
| | FRN55VG1□-4□** | HD | | |
| | | LD | | |
| | FRN75VG1□-4□** | HD | | |
| | | LD | | |
| | FRN90VG1□-4□** | HD | | |
| | | MD | FS5536-250-99-1 | |
| | | LD | | |
| | FRN110VG1□-4□** | HD | | |
| | | MD | | |
| | | LD | | |
| | FRN132VG1□-4□** | HD | FS5536-250-99-1 | |
| | | MD | FS5536-400-99-1 | |
| | | LD | | |
| | FRN160VG1□-4□** | HD | | |
| | | MD | | |
| | | LD | | |
| | FRN200VG1□-4□** | HD | | |
| | | MD | | |
| | | LD | | |
| | FRN220VG1□-4□** | HD | | |
| | | MD | FN3359-600-99 | |
| | | LD | | |
| | FRN280VG1□-4□** | HD | | |
| | | MD | | |
| | | LD | FN3359-800-99 | |
| | FRN315VG1□-4□** | HD | FN3359-600-99 | |
| | | MD | FN3359-800-99 | |
| | | LD | | |
| | FRN355VG1□-4□** | HD | | |
| | | MD | | |
| | | LD | | |
| | FRN400VG1□-4□** | HD | | |
| | | MD | | |
| | | LD | FN3359-1000-99 | |
| | FRN500VG1□-4□** | HD | | |
| | | LD | FN3359-1600-99 | |
| | FRN630VG1□-4□** | HD | | |
| | | LD | | |

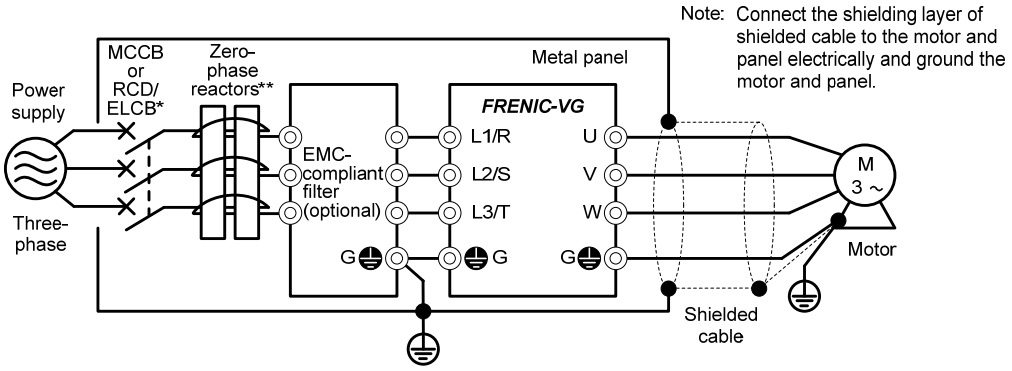
**Note:** A box (□) replaces an alphabetic letter depending on the enclosure or the shipping destination. Refer to Chapter 1, Section 1.1.

■ **Recommended installation procedure**

To make the machinery or equipment fully compliant with the EMC Directive, have certified technicians wire the motor and inverter in strict accordance with the procedure described below.

When an EMC-compliant filter (option) is externally used

1) Mount the inverter and the filter on a grounded panel or metal plate. Use shielded wires for the motor cable and route the cable as short as possible. Firmly clamp the shields to the metal plate to ground them. Further, connect the shielding layers electrically to the grounding terminal of the motor.
2) For connection to inverter's control terminals and for connection of the RS-485 communication signal cable, use shielded wires. As with the motor, clamp the shields firmly to a grounded panel.
3) If noise from the inverter exceeds the permissible level, enclose the inverter and its peripherals within a metal panel as shown in Figure 8.1-1.




* With overcurrent protection

** Two zero-phase reactors ACL-74B (Number of pass-throughs: 2) are essential when an EMC filter EFL-22SP-2 is used.

Figure 8.1-1 Mounting an EMC-compliant Filter (option) in a Metal Panel

### 8.1.2 Harmonic component regulation in the EU

When you use general-purpose industrial inverters in the EU, the harmonics emitted from the inverter to power lines are strictly regulated as stated below.

If an inverter whose rated input is 1 kW or less is connected to public low-voltage power supply, it is regulated by the harmonics emission regulations from inverters to power lines (with the exception of industrial low-voltage power lines). Refer to Figure 8.1-2 below for details.

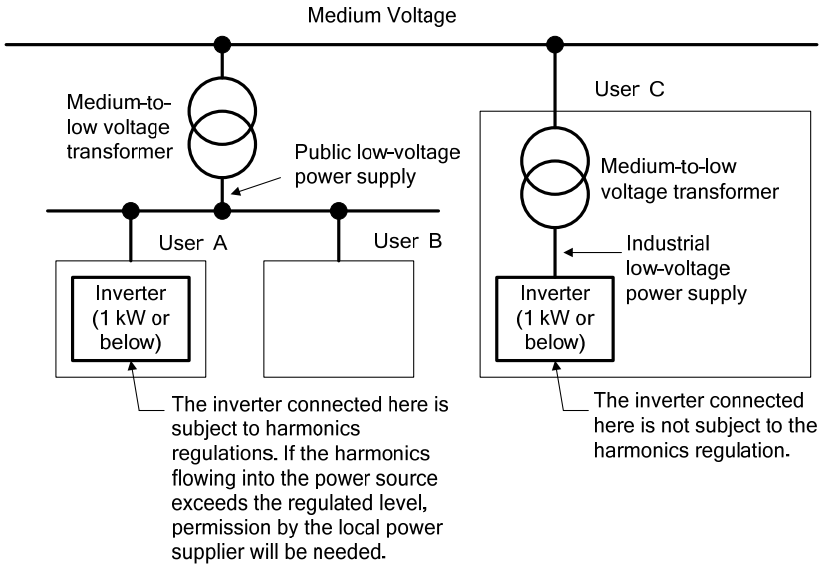



Figure 8.1-2 Power Source and Regulation

Table 8.1-2 Compliance with Harmonic Component Regulation

| Power supply voltage | Inverter type | w/o DC reactor | w/ DC reactor | Applicable DC reactor type |
|---|---|---|---|---|
| Three-phase 200 V | FRN0.75G1□-2□ | √ | √ | DCR2-0.75 |

* When supplying three-phase 200 VAC power stepped down from a three-phase 400 VAC power line using a transformer, the level of harmonic flow from the 400 VAC line will be regulated.

Note 1) A box (□) replaces an alphabetic letter depending on the enclosure or the shipping destination. For details, refer to Chapter 1, Section 1.1.

Note 2) Inverter types marked with √ in the table above are compliant with the EN61000-3-2 (+A14), so they may be connected to public low-voltage power supply unconditionally.

Conditions apply when connecting models marked with "—". To connect them to public low-voltage power supply, you need to obtain permission from the local electric power supplier. In general, you will need to provide the supplier with the harmonics current data of the inverter. To obtain the data, contact your Fuji Electric representative.

### 8.1.3 Compliance with the low voltage directive in the EU

General-purpose inverters are regulated by the Low Voltage Directive in the EU. Fuji Electric states that all our inverters with CE marking are compliant with the Low Voltage Directive.

**■ Note**

If installed according to the guidelines given below, inverters marked with CE are considered as compliant with the Low Voltage Directive 2006/95/EC.

**Compliance with European Standards**

Adjustable speed electrical power drive systems (PDS).

Part 5-1: Safety requirements. Electrical, thermal and energy. IEC/EN61800-5-1: 2007

## ⚠ WARNING ⚠

1. The ground terminal ⏚G should always be connected to the ground. Do not use only a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB)* as the sole method of electric shock protection. Be sure to use ground wires whose size is greater than power supply lines.

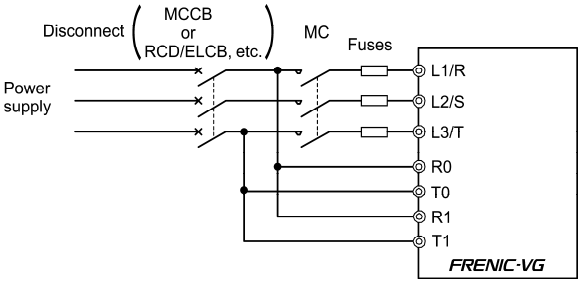
   *With overcurrent protection.

2. To prevent the risk of hazardous accidents that could be caused by damage of the inverter, install the specified fuses in the supply side (primary side) according to the following tables.

   - Breaking capacity: Min. 10 kA
   - Rated voltage: Min. 500 V

| Power supply voltage | Nominal applied motor (kW) | Inverter type | HD/ MD/LD mode | Fuse rating (A) |
|---|---|---|---|---|
| Three-phase 200 V | 0.75 | FRN0.75VG1□-2□ | HD | 15(IEC60269-4) |
| | 1.5 | FRN1.5VG1□-2□ | | 20(IEC60269-4) |
| | 2.2 | FRN2.2VG1□-2□ | | 30(IEC60269-4) |
| | 3.7 | FRN3.7VG1□-2□ | | 40(IEC60269-4) |
| | 5.5 | FRN5.5VG1□-2□ | | 125(IEC60269-4) |
| | 7.5 | FRN7.5VG1□-2□ | | 160(IEC60269-4) |
| | 11 | FRN11VG1□-2□ | | 160(IEC60269-4) |
| | 15 | FRN15VG1□-2□ | | 200(IEC60269-4) |
| | 18.5 | FRN18.5VG1□-2□ | | 250(IEC60269-4) |
| | 22 | FRN22VG1□-2□ | | 250(IEC60269-4) |
| | 30 | FRN30VG1□-2□ | HD | 350(IEC60269-4) |
| | 37 | | LD | |
| | 37 | FRN37VG1□-2□ | HD | 400(IEC60269-4) |
| | 45 | | LD | |
| | 45 | FRN45VG1□-2□ | HD | 450(IEC60269-4) |
| | 55 | | LD | |
| | 55 | FRN55VG1□-2□ | HD | 500(IEC60269-4) |
| | 75 | | LD | |
| | 75 | FRN75VG1□-2□ | HD | |
| | 90 | | LD | |
| | 90 | FRN90VG1□-2□ | HD | |
| | 110 | | LD | |

**Note:** A box (□) replaces an alphabetic letter depending on the enclose and the shipping destination.




| Power supply voltage | Nominal applied motor (kW) | Inverter type | HD/ MD/LD mode | Fuse rating (A) |
|---|---|---|---|---|
| Three-phase 400V | 3.7 | FRN3.7VG1□-4□ | HD | 20(IEC60269-4) |
| | 5.5 | FRN5.5VG1□-4□ | HD | 80(IEC60269-4) |
| | 7.5 | FRN7.5VG1□-4□ | HD | 80(IEC60269-4) |
| | 11 | FRN11VG1□-4□ | HD | 125(IEC60269-4) |
| | 15 | FRN15VG1□-4□ | HD | 125(IEC60269-4) |
| | 18.5 | FRN18.5VG□-4□ | HD | 160(IEC60269-4) |
| | 22 | FRN22VG1□-4□ | HD | 160(IEC60269-4) |
| | 30 | FRN30VG1□-4□ | HD | 250(IEC60269-4) |
| | 37 | | LD | |
| | 37 | FRN37VG1□-4□ | HD | 315(IEC60269-4) |
| | 45 | | LD | |
| | 45 | FRN45VG1□-4□ | HD | 315(IEC60269-4) |
| | 55 | | LD | |
| | 55 | FRN55VG1□-4□ | HD | 350(IEC60269-4) |
| | 75 | | LD | 350(IEC60269-4) |
| | 75 | FRN75VG1□-4□ | HD | 350(IEC60269-4) |
| | 90 | | LD | |
| | 90 | FRN90VG1□-4□ | HD | 350(IEC60269-4) |
| | 110 | | MD/LD | |
| | 110 | FRN110VG1□-4□ | HD | 400(IEC60269-4) |
| | 132 | | MD/LD | |
| | 132 | FRN132VG1□-4□ | HD | 450(IEC60269-4) |
| | 160 | | MD/LD | |
| | 160 | FRN160VG1□-4□ | HD | 500(IEC60269-4) |
| | 200 | | MD/LD | |
| | 200 | FRN200VG1□-4□ | HD | 550(IEC60269-4) |
| | 220 | | MD/LD | |
| | 220 | FRN220VG1□-4□ | HD | 630(IEC60269-4) |
| | 250 | | MD | |
| | 280 | | LD | |
| | 280 | FRN280VG1□-4□ | HD | 900(IEC60269-4) |
| | 315 | | MD | |
| | 355 | | LD | |
| | 315 | FRN315VG1□-4□ | HD | |
| | 355 | | MD | |
| | 400 | | LD | |
| | 355 | FRN355VG1□-4□ | HD | 1250 (IEC60269-4) |
| | 400 | | MD | |
| | 450 | | LD | |
| | 400 | FRN400VG1□-4□ | HD | |
| | 450 | | MD | |
| | 500 | | LD | |
| | 500 | FRN500VG1□-4□ | HD | 2000 (IEC60269-4) |
| | 630 | | LD | |
| | 630 | FRN630VG1□-4□ | HD | |
| | 710 | | LD | |

**Conformity to the Low Voltage Directive in the EU (Continued)**

## ⚠ WARNING ⚠

3. When used with the inverter, a molded case circuit breaker (MCCB), residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) or magnetic contactor (MC) should conform to the EN or IEC standards.
4. When you use a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) for protection from electric shock in direct or indirect contact power lines or nodes, be sure to install type B of RCD/ELCB on the input (primary) of the inverter if the power supply is three-phase 200/400 V.
5. The inverter should be used in an environment that does not exceed Pollution Degree 2 requirements. If the environment conforms to Pollution Degree 3 or 4, install the inverter in an enclosure of IP54 or higher.
6. Install the inverter, AC or DC reactor, input or output filter in an enclosure with minimum degree of protection of IP2X (Top surface of enclosure shall be minimum IP4X when it can be easily accessed), to prevent human body from touching directly to live parts of these equipment.
7. Do not connect any copper wire directly to grounding terminals. Use crimp terminals with tin or equivalent plating to connect them.
8. When you use an inverter at an altitude of more than 2000 m, you should apply basic insulation for the control circuits of the inverter. The inverter cannot be used at altitudes of more than 3000 m.
9. Use wires listed in IEC60364-5-52.

| Power supply voltage | Nominal applied motor | Inverter type | HD/LD mode | MCCB or RCD/ELCB *1 Rated current | | Recommended wire size (mm2) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Main circuit | | | | Control circuit | Aux. control power supply [R0, T0] | Aux. fan power supply [R1, T1] |
| | | | | | | Main power input *2 [L1/R, L2/S, L3/T] Inverter's grounding [⏚G] | | Inverter outputs [U, V, W] *2 | DC reactor [P1, P(+)] *2 | Braking resistor [P(+), DB] *2 | | |
| | | | | W/ DCR | W/o DCR | W/ DCR | W/o DCR | | | | | |
| Three-phase 200 V | 0.75 | FRN0.75VG1□-2□ | HD | 5 | 10 | 1 | 1 | 1 | 1 | 1 | 0.75 | 2.5 | - |
| | 1.5 | FRN1.5VG1□-2□ | HD | 10 | 15 | | | | | | | |
| | 2.2 | FRN2.2VG1□-2□ | HD | 10 | 20 | | 1.5 | | | | | |
| | 3.7 | FRN3.7VG1□-2□ | HD | 20 | 30 | 2.5 | 4 | 2.5 | 2.5 | | | |
| | 5.5 | FRN5.5VG1□-2□ | HD | 30 | 50 | 4 | 6 | 4 | 4 | | | |
| | 7.5 | FRN7.5VG1□-2□ | HD | 40 | 75 | 6 | 10 | 10 | 6 | | | |
| | 11 | FRN11VG1□-2□ | HD | 50 | 100 | 10 | 16 | | 16 | | | |
| | 15 | FRN15VG1□-2□ | HD | 75 | 125 | 16 | 25 | 16 | 25 | | | |
| | 18.5 | FRN18.5VG1□-2□ | HD | 100 | 150 | 25 | 35 | 25 | 35 | 1.5 | | |
| | 22 | FRN22VG1□-2□ | HD | | 175 | 35 | 50 | 35 | | | | |
| | 30 | FRN30VG1□-2□ | HD | 150 | 200 | 50 | 70 | 50 | 70 | 2.5 | | |
| | 37 | | LD | 175 | 250 | 70 | 95 | 70 | 95 | | | 2.5 |
| | | FRN37VG1□-2□ | HD | | | | | | | 4 | | |
| | 45 | | LD | 200 | 300 | 95 | 70×2 | 95 | 50×2 | | | |
| | | FRN45VG1□-2□ | HD | | | | | | | 6 | | |
| | 55 | | LD | 250 | 350 | 50×2 | 95×2 | 70×2 | 70×2 | | | |
| | | FRN55VG1□-2□ | HD | | | | | | | 10 | | |
| | 75 | | LD | 350 | - | 95×2 | - | 95×2 | 95×2 | | | |
| | | FRN75VG1□-2□ | HD | | | | | | | - | | |
| | 90 | | LD | 400 | | 120×2 | | 120×2 | 120×2 | | | |
| | | FRN90VG1□-2□ | HD | | | | | | | | | |
| | 110 | | LD | 500 | | 150×2 | | 150×2 | 150×2 | | | |

**Note:** A box (□) replaces an alphabetic letter depending on the enclosure or the shipping destination.

*1 The frame size and model of the MCCB or RCD/ELCB (with overcurrent protection) will vary, depending on the power transformer capacity. Refer to the related technical documentation for details.

*2 The recommended wire size for main circuits is for the 70°C 600 V PVC wires used at a surrounding temperature of 40°C.

**Conformity to the Low Voltage Directive in the EU (Continued)**

## ⚠WARNING⚠

| Power supply voltage | Nominal applied motor | Inverter type | HD/LD mode | MCCB or RCD/ELCB *1 Rated current | | Recommended wire size ($mm^2$) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Main circuit | | | | | | |
| | | | | | | Main power input *2 [L1/R, L2/S, L3/T] Inverter's grounding [⏚G] | | Inverter outputs [U, V, W] *2 | DC reactor [P1, P(+)] *2 | Braking resistor [P(+), DB] *2 | Control circuit | Aux. control power supply [R0, T0] | Aux. fan power supply [R1, T1] |
| | | | | W/ DCR | W/o DCR | W/ DCR | W/o DCR | | | | | | |
| Three--phase 400 V | 3.7 | FRN3.7VG1☐-4☐ | HD | 10 | 20 | 1 | 1.5 | 1 | 1 | 1 | 0.75 | 2.5 | - |
| | 5.5 | FRN5.5VG1☐-4☐ | HD | 15 | 30 | | 2.5 | 1.5 | 1.5 | | | | |
| | 7.5 | FRN7.5VG1☐-4☐ | HD | 20 | 40 | 1.5 | 4 | 2.5 | 2.5 | | | | |
| | 11 | FRN11VG1☐-4☐ | HD | 30 | 50 | 4 | 6 | 4 | 4 | | | | |
| | 15 | FRN15VG1☐-4☐ | HD | 40 | 60 | 6 | 10 | 6 | 6 | | | | |
| | 18.5 | FRN18.5VG1☐-4☐ | HD | | 75 | | 16 | 10 | 10 | | | | |
| | 22 | FRN22VG1☐-4☐ | HD | 50 | 100 | 10 | | | 16 | | | | |
| | 30 | FRN30VG1☐-4☐ | HD | 75 | 125 | 16 | 25 | 16 | 25 | | | | |
| | 37 | | LD | 100 | | 25 | 35 | 25 | | 1.5 | | | |
| | | FRN37VG1☐-4☐ | HD | | | | | | | | | | |
| | 45 | | LD | | 150 | | 50 | 35 | 35 | | | | |
| | | FRN45VG1☐-4☐ | HD | | | | | | | | | | |
| | 55 | | LD | 125 | 200 | 35 | 70 | 50 | 70 | 2.5 | | | |
| | | FRN55VG1☐-4☐ | HD | | | | | | | | | | |
| | 75 | | LD | 175 | - | 70 | - | 70 | 95 | 4 | | | 2.5 |
| | | FRN75VG1☐-4☐ | HD | | | | | | | | | | |
| | 90 | | LD | 200 | | 95 | | 95 | 120 | - | | | |
| | | FRN90VG1☐-4☐ | HD | | | | | | | | | | |
| | 110 | | MD/LD | 250 | | 50×2 | | 70×2 | 150 | | | | |
| | | FRN110VG1☐-4☐ | HD | | | | | | | | | | |
| | 132 | | MD/LD | 300 | | 70×2 | | | 70×2 | | | | |
| | | FRN132VG1☐-4☐ | HD | | | | | | | | | | |
| | 160 | | MD/LD | 350 | | 185 | | 240 | 300 | | | | |
| | | FRN160VG1☐-4☐ | HD | | | | | | | | | | |
| | 200 | | MD/LD | 500 | | 300 | | 300 | 120×2 | | | | |
| | | FRN200VG1☐-4☐ | HD | | | | | | | | | | |
| | 220 | | MD/LD | | | | | 150×2 | 150×2 | | | | |
| | | FRN220VG1☐-4☐ | HD | | | | | | | | | | |

**Note:** A box (☐) replaces an alphabetic letter depending on the enclosure or the shipping destination.

*1 The frame size and model of the MCCB or RCD/ELCB (with overcurrent protection) will vary, depending on the power transformer capacity. Refer to the related technical documentation for details.

*2 The recommended wire size for main circuits is for the 70°C 600 V PVC wires used at a surrounding temperature of 40°C.

**Conformity to the Low Voltage Directive in the EU (Continued)**

## ⚠WARNING⚠

| Power supply voltage | Nominal applied motor | Inverter type | HD/LD mode | MCCB or RCD/ELCB *1 Rated current | | Recommended wire size ($mm^2$) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Main circuit | | | | | | |
| | | | | | | Main power input *2 [L1/R, L2/S, L3/T] Inverter's grounding [⏚G] | | Inverter outputs [U, V, W] *2 | DC reactor [P1, P(+)] *2 | Braking resistor [P(+), DB] *2 | Control circuit | Aux. control power supply [R0, T0] | Aux. fan power supply [R1, T1] |
| | | | | W/ DCR | W/o DCR | W/ DCR | W/o DCR | | | | | | |
| Three--phase 400 V | 3.7 | FRN3.7VG1☐-4☐ | HD | 10 | 20 | 1 | 1.5 | 1 | 1 | 1 | 0.75 | 2.5 | - |
| | 5.5 | FRN5.5VG1☐-4☐ | HD | 15 | 30 | | 2.5 | 1.5 | 1.5 | | | | |
| | 7.5 | FRN7.5VG1☐-4☐ | HD | 20 | 40 | 1.5 | 4 | 2.5 | 2.5 | | | | |
| | 11 | FRN11VG1☐-4☐ | HD | 30 | 50 | 4 | 6 | 4 | 4 | | | | |
| | 15 | FRN15VG1☐-4☐ | HD | 40 | 60 | 6 | 10 | 6 | 6 | | | | |
| | 18.5 | FRN18.5VG1☐-4☐ | HD | | 75 | | 16 | 10 | 10 | | | | |
| | 22 | FRN22VG1☐-4☐ | HD | 50 | 100 | 10 | | | 16 | | | | |
| | 30 | FRN30VG1☐-4☐ | HD | 75 | 125 | 16 | 25 | 16 | 25 | | | | |
| | 37 | | LD | 100 | | 25 | | 25 | | | | | |
| | | FRN37VG1☐-4☐ | HD | | | | 35 | | | 1.5 | | | |
| | 45 | | LD | | 150 | | 50 | 35 | 35 | | | | |
| | | FRN45VG1☐-4☐ | HD | | | | | | | | | | |
| | 55 | | LD | 125 | 200 | 35 | 70 | 50 | 70 | | | | |
| | | FRN55VG1☐-4☐ | HD | | | | | | | 2.5 | | | |
| | 75 | | LD | 175 | - | 70 | - | 70 | 95 | | | | 2.5 |
| | | FRN75VG1☐-4☐ | HD | | | | | | | 4 | | | |
| | 90 | | LD | 200 | | 95 | | 95 | 120 | | | | |
| | | FRN90VG1☐-4☐ | HD | | | | | | | - | | | |
| | 110 | | MD/LD | 250 | | 50×2 | | 70×2 | 150 | | | | |
| | | FRN110VG1☐-4☐ | HD | | | | | | | | | | |
| | 132 | | MD/LD | 300 | | 70×2 | | | 70×2 | | | | |
| | | FRN132VG1☐-4☐ | HD | | | | | | | | | | |
| | 160 | | MD/LD | 350 | | 185 | | 240 | 300 | | | | |
| | | FRN160VG1☐-4☐ | HD | | | | | | | | | | |
| | 200 | | MD/LD | 500 | | 300 | | 300 | 120×2 | | | | |
| | | FRN200VG1☐-4☐ | HD | | | | | | | | | | |
| | 220 | | MD/LD | | | | | 150×2 | 150×2 | | | | |
| | | FRN220VG1☐-4☐ | HD | | | | | | | | | | |

**Note:** A box (☐) replaces an alphabetic letter depending on the enclosure or the shipping destination.

*1 The frame size and model of the MCCB or RCD/ELCB (with overcurrent protection) will vary, depending on the power transformer capacity. Refer to the related technical documentation for details.

*2 The recommended wire size for main circuits is for the 70°C 600 V PVC wires used at a surrounding temperature of 40°C.

**Conformity to the Low Voltage Directive in the EU (Continued)**

## ⚠WARNING⚠

| Power supply voltage | Nominal applied motor | Inverter type | HD/LD mode | MCCB or RCD/ELCB *1 Rated current | | Recommended wire size ($mm^2$) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Main circuit | | | | | Control circuit | Aux. control power supply [R0, T0] | Aux. fan power supply [R1, T1] |
| | | | | | | Main power input *2 [L1/R, L2/S, L3/T] Inverter's grounding [⏚G] | | Inverter outputs [U, V, W] *2 | DC reactor [P1, P(+)] *2 | Braking resistor [P(+), DB] *2 | | | |
| | | | | W/ DCR | W/o DCR | W/ DCR | W/o DCR | | | | | | |
| Three-phase 400 V | 250 | FRN220VG1☐-4☐ | MD | 600 | - | 185×2 | - | 185×2 | 185×2 | — | 0.75 | 2.5 | 2.5 |
| | 280 | | LD | | | 240×2 | | 240×2 | 240×2 | | | | |
| | | FRN280VG1☐-4☐ | HD | | | | | | | | | | |
| | 315 | | MD | 800 | | | | 300×2 | | | | | |
| | | FRN315VG1☐-4☐ | HD | | | | | | | | | | |
| | 355 | FRN280VG1☐-4☐ | LD | | | 300×2 | | | 300×2 | | | | |
| | | FRN315VG1☐-4☐ | MD | | | | | | | | | | |
| | | FRN355VG1☐-4☐ | HD | | | | | | | | | | |
| | 400 | FRN315VG1☐-4☐ | LD | 1200 | | 240×3 | | 240×3 | 300×3 | | | | |
| | | FRN355VG1☐-4☐ | MD | | | | | | | | | | |
| | | FRN400VG1☐-4☐ | HD | | | | | | | | | | |
| | 450 | FRN355VG1☐-4☐ | LD | | | 300×3 | | 300×3 | 240×4 | | | | |
| | | FRN400VG1☐-4☐ | MD | | | | | | | | | | |
| | 500 | | LD | | | | | 240×4 | 300×4 | | | | |
| | | FRN500VG1☐-4☐ | HD | | | | | | | | | | |
| | 630 | | LD | 1400 | | 300×4 | | 300×4 | | | | | |
| | | FRN630VG1☐-4☐ | HD | | | | | | | | | | |
| | 710 | | LD | 1600 | | | | | | | | | |

**Note:** A box (☐) replaces an alphabetic letter depending on the enclosure or the shipping destination.

*1 The frame size and model of the MCCB or RCD/ELCB (with overcurrent protection) will vary, depending on the power transformer capacity. Refer to the related technical documentation for details.

*2 The recommended wire size for main circuits is for the 70°C 600 V PVC wires used at a surrounding temperature of 40°C.

10. The inverter has been tested with IEC/EN61800-5-1 2007 5.2.3.6.3 Short-circuit Current Test under the following conditions.

Short-circuit current in the supply: 10,000 Af

Maximum 240 V for 200 V class series with 22 kW or below
Maximum 230 V for 200 V class series with 30 kW or above
Maximum 480 V for 400 V class series

## 8.2 Compliance with UL Standards and Canadian Standards (cUL certification)) ( c UL us LISTED )

Originally, the UL standards were established by Underwriters Laboratories, Inc. as private criteria for inspections/investigations pertaining to fire/accident insurance in the USA. Later, these standards were authorized as the official standards to protect operators, service personnel and the general populace from fires and other accidents in the USA.

cUL certification means that UL has given certification for products to clear CSA Standards. cUL certified products are equivalent to those compliant with CSA Standards.

■ **Notes**

UL/cUL-listed inverters are subject to the regulations set forth by the UL standards and CSA standards (cUL-listed for Canada) by installation within precautions listed below.

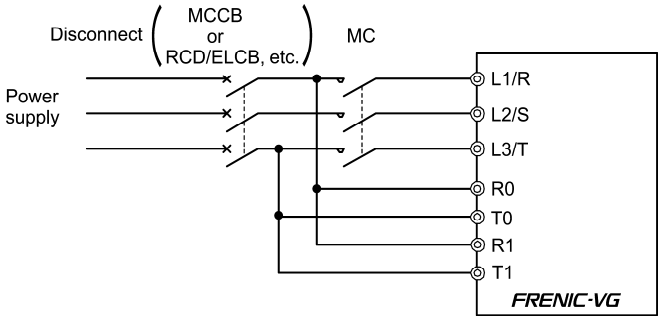
### ⚠CAUTION

1. Solid state motor overload protection (motor protection by electronic thermal overload relay) is provided in each model. Use function codes F10 to F12 to set the protection level.
2. Use Cu wire only.
3. Use Class 1 wire only for control circuits.
4. Short circuit rating

   "Suitable For Use On A Circuit Of Delivering Not More Than 100,000 rms Symmetrical Amperes, 240 Volts Maximum for 200V class input 22 kW or less, 230 Volts maximum for 200V class input 30 kW or above when protected by Class J Fuses or a Circuit Breaker having an interrupting rating not less than 100,000 rms Symmetrical Amperes, 240 Volts Maximum." Models FRN; rated for 200V class input.

   "Suitable For Use On A Circuit Of Delivering Not More Than 100,000 rms Symmetrical Amperes, 480 Volts Maximum when protected by Class J Fuses or a Circuit Breaker having an interrupting rating not less than 100,000 rms Symmetrical Amperes, 480 Volts Maximum." Models FRN; rated for 400V class input.

   "Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes."
5. Field wiring connections must be made by a UL Listed and CSA Certified closed-loop terminal connector sized for the wire gauge involved. Connector must be fixed using the crimp tool specified by the connector manufacturer.
6. All circuits with terminals L1/R, L2/S, L3/T, R0, T0, R1, T1 must have a common disconnect and be connected to the same pole of the disconnect if the terminals are connected to the power supply.



**Conformity with UL standards and CSA standards (cUL-listed for Canada) (continued)**

## ⚠CAUTION

7. Environmental Requirements
   - Surrounding/ ambient temperature
     Maximum Surrounding Air Temperature 50°C
   - Atmosphere
     For use in pollution degree 2 environments.（for Open-Type models）
8. Install UL certified fuses or circuit breaker between the power supply and the inverter, referring to the table below.

| Power supply voltage | Nominal applied motor | Inverter type | HD/LD mode | Class J fuse size | Circuit breaker trip size | Required torque lb-in (N·m) | | | Wire size AWG (mm²) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Main terminal | | | | | | | | |
| | | | | | | | | | L1/R, L2/S, L3/T | | | U, V, W | | | Aux. control power supply | Aux. fan power supply |
| | | | | | | Main terminal | Aux. control power supply | Aux. Fan power supply | 60°C Cu wire | 75°C Cu wire | Remarks | 60°C Cu wire | 75°C Cu wire | Remarks | | |
| Three-phase 200V | 0.75 | FRN0.75VG1□-2□ | HD | 15 | 10 | 30.9 (3.5) | 10.6 (1.2) | - | 14 (2.1) | 14 (2.1) | *1 - | 14 (2.1) | 14 (2.1) | *1 - | 14 (2.1) *1 *2 | - |
| | 1.5 | FRN1.5VG1□-2□ | | 20 | 15 | | | | | | | | | | | |
| | 2.2 | FRN2.2VG1□-2□ | | 30 | 20 | | | | | | | | | | | |
| | 3.7 | FRN3.7VG1□-2□ | | 40 | 30 | | | | 10 (5.3) | 10 (5.3) | | 12 (3.3) | 12 (3.3) | | | |
| | 5.5 | FRN5.5VG1□-2□ | | 60 | 50 | | | | 8 (8.4) | 8 (8.4) | | 10 (5.3) | 10 (5.3) | | | |
| | 7.5 | FRN7.5VG1□-2□ | | 75 | 75 | | | | - | | *2 | 8 (8.4) | 8 (8.4) | | | |
| | 11 | FRN11VG1□-2□ | | 100 | 100 | 51.3 (5.8) | | | 4 (21.2) | 6 (13.3) | | 6 (13.3) | 6 (13.3) | | | |
| | 15 | FRN15VG1□-2□ | | 150 | 125 | | | | 3 (26.7) | 4 (21.2) | - | 4 (21.2) | | | | |
| | 18.5 | FRN18.5VG1□-2□ | | 175 | 150 | | | | 1 (42.4) | 3 (26.7) | | 3 (26.7) | 4 (21.2) | | | |
| | 22 | FRN22VG1□-2□ | | 200 | 175 | | | | - | 2 (33.6) | | 2 (33.6) | 3 (26.7) | | | |
| | 30 | FRN30VG1□-2□ | HD | 250 | 200 | 119.4 (13.5) | | | | 2/0 (67.4) | | - | 1 (42.4) | | - | *2 | |
| | 37 | | LD | 350 | 250 | | | | | 3/0 (85) | - | | 1/0 (53.5) | - | | | |
| | | FRN37VG1□-2□ | HD | | | 238.9 (27) | | 10.6 (1.2) | | | | | 4/0 (107.2) | | | | 14 (2.1) |
| | 45 | | LD | 400 | 300 | | | | | 4/0 (107.2) | *2 | - | | | | | |
| | | FRN45VG1□-2□ | HD | | | | | | | | | | | | | | |
| | 55 | | LD | 450 | 350 | | | | | 2/0×2 (67.4×2) | | | | *2 | | | |
| | | FRN55VG1□-2□ | HD | | | | | | | | | | | | | | |
| | 75 | | LD | 500 | | | | | | 3/0×2 (85×2) | | | 3/0×2 (85×2) | | | | |
| | | FRN75VG1□-2□ | HD | | | 424.7 (48) | | | | | | | | | | | |
| | 90 | | LD | 600 | 400 | | | | | 4/0×2 (107.2×2) | | | 4/0×2 (107.2×2) | | | | |
| | | FRN90VG1□-2□ | HD | | | | | | | | | | | | | | |
| | 110 | | LD | 700 | 500 | | | | | 300×2 (152×2) | | | 300×2 (152×2) | | | | |

**Note 1:** Control circuit terminals Tightening torque: 6.1 lb-in (0.7 N·m), Recommended wire size: AWG16 (1.25 mm²)

**Note 2:** A box (□) replaces an alphabetic letter depending on the shipping destination.

*1 No terminal end treatment is required for connection.

*2 Use 75°C Cu wire only.

**Conformity with UL standards and CSA standards (cUL-listed for Canada) (continued)**

## ⚠CAUTION

| Power supply voltage | Nominal applied motor | Inverter type | HD/MD/LD mode | Class J fuse size | Circuit breaker trip size | Required torque lb-in (N·m) | | | Wire size AWG (mm²) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Main terminal | | | | | | | | | |
| | | | | | | | | | L1/R, L2/S, L3/T | | | U, V, W | | | | | | |
| | | | | | | Main terminal | Aux. control power supply | Aux. Fan power supply | 60°C Cu wire | 75°C Cu wire | Remarks | 60°C Cu wire | 75°C Cu wire | Remarks | | | Aux. control power supply | Aux. fan power supply |
| Three-phase 400V | 3.7 | FRN3.7VG1□-4□ | HD | 20 | 20 | 30.9 (3.5) | 10.6 (1.2) | - | 14 (2.1) | 14 (2.1) | *1 | - | 14 (2.1) | 14 (2.1) | *1 | - | 14 (2.1) *1 *2 | - |
| | 5.5 | FRN5.5VG1□-4□ | | 30 | 30 | | | | 12 (3.3) | 12 (3.3) | | | | | | | | |
| | 7.5 | FRN7.5VG1□-4□ | | 40 | 40 | | | | 10 (5.3) | 10 (5.3) | | | 12 (3.3) | 12 (3.3) | | | | |
| | 11 | FRN11VG1□-4□ | | 60 | 50 | 51.3 (5.8) | | | 6 (13.3) | 6 (13.3) | - | | 6 (13.3) | 6 (13.3) | - | | | |
| | 15 | FRN15VG1□-4□ | | 70 | 60 | | | | | | | | | | | | | |
| | 18.5 | FRN18.5VG1□-4□ | | 90 | 75 | | | | | | | | | | | | | |
| | 22 | FRN22VG1□-4□ | | 100 | 100 | | | | 4 (21.2) | | | | | | | | | |
| | 30 | FRN30VG1□-4□ | HD | 125 | 125 | 119.4 (13.5) | | | 3 (26.7) | 4 (21.2) | | | 2 (33.6) | 2 (33.6) | | | | |
| | 37 | | LD | 175 | | | | | 2 (33.6) | 3 (26.7) | | | | | | | | |
| | | FRN37VG1□-4□ | HD | | | | | | | | | | | | | | | |
| | 45 | | LD | 200 | 150 | | | | - | 2 (33.6) | - | *2 | - | | *2 | | | |
| | | FRN45VG1□-4□ | HD | | | | | | | | | | | | | | | |
| | 55 | | LD | 250 | 200 | | | | | 1/0 (53.5) | | | | | | | | |
| | | FRN55VG1□-4□ | HD | | | | | | | | | | | | | | | |
| | 75 | | LD | | 175 | | | | | | | | | 1/0 (53.5) | | | | |
| | | FRN75VG1□-4□ | HD | | | 238.9 (27) | | 10.6 (1.2) | | 2/0 (67.4) | | | | 4/0 (107.2) | | | | 14 (2.1) *1 *2 |
| | 90 | | LD | 300 | 200 | | | | | | | | | | | | | |
| | | FRN90VG1□-4□ | HD | | | | | | | | | | | | | | | |
| | 110 | | MD/LD | 350 | 250 | | | | | 1/0×2 (53.5×2) | | | | 1/0×2 (53.5×2) | | | | |
| | | FRN110VG1□-4□ | HD | | | | | | | | | | | | | | | |
| | 132 | | MD/LD | 400 | 300 | | | | | | | | | 2/0×2 (67.4×2) | | | | |
| | | FRN132VG1□-4□ | HD | | | 424.7 (48) | | | | 3/0×2 (85×2) | | | | 3/0×2 (85×2) | | | | |
| | 160 | | MD/LD | 500 | 350 | | | | | | | | | | | | | |
| | | FRN160VG1□-4□ | HD | | | | | | | 4/0×2 (107.2×2) | | | | 250×2 (127×2) | | | | |
| | 200 | | MD/LD | 600 | 500 | | | | | | | | | | | | | |
| | | FRN200VG1□-4□ | HD | | | | | | | 250×2 (127×2) | | | | 300×2 (152×2) | | | | |
| | 220 | | MD/LD | 700 | | | | | | | | | | | | | | |
| | | FRN220VG1□-4□ | HD | | | | | | | | | | | | | | | |

**Note 1:** Control circuit terminals Tightening torque: 6.1 lb-in (0.7 N·m), Recommended wire size: AWG16 (1.25 mm²)

**Note 2:** A box (□) replaces an alphabetic letter depending on the specifications.

*1 No terminal end treatment is required for connection.

*2 Use 75°C Cu wire only.

**Conformity with UL standards and CSA standards (cUL-listed for Canada) (continued)**

## ⚠CAUTION

| Power supply voltage | Nominal applied motor | Inverter type | HD/MD/LD mode | Class J fuse size | Circuit breaker trip size | Required torque lb-in (N·m) | | | Wire size AWG (mm²) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Main terminal | | | | | | Aux. control power supply | Aux. fan power supply |
| | | | | | | | | | L1/R, L2/S, L3/T | | | L1/R, L2/S, L3/T | | | | |
| | | | | | | Main terminal | Aux. control power supply | Aux. Fan power supply | 60°C Cu wire | 75°C Cu wire | Remarks | 60°C Cu wire | 75°C Cu wire | Remarks | | |
| Three-phase 400V | 250 | FRN220VG1☐-4☐ | MD | 800 | 600 | 424.7 (48) | 10.6 (1.2) | 10.6 (1.2) | - | 300×2 (152×2) | - *2 | - | 350×2 (177×2) | - *2 | 14 (2.1) *1 *2 | 14 (2.1) *1 *2 |
| | 280 | | LD | 1000 | | | | | | 400×2 (203×2) | | | 400×2 (203×2) | | | |
| | | FRN280VG1☐-4☐ | HD | | | | | | | 250×2 (127×2) | | | 300×2 (152×2) | | | |
| | 315 | | MD | | 800 | | | | | 300×2 (152×2) | | | 350×2 (177×2) | | | |
| | | FRN315VG1☐-4☐ | HD | | | | | | | | | | | | | |
| | 355 | FRN280VG1☐-4☐ | LD | 1200 | | | | | | 400×2 (203×2) | | | 400×2 (203×2) | | | |
| | | FRN315VG1☐-4☐ | MD | | | | | | | | | | | | | |
| | | FRN355VG1☐-4☐ | HD | | | | | | | | | | | | | |
| | 400 | FRN315VG1☐-4☐ | LD | | 1200 | | | | | 500×2 (253×2) | *2 *3 | | 500×2 (253×2) | *2 *3 | | |
| | | FRN355VG1☐-4☐ | MD | | | | | | | | | | | | | |
| | | FRN400VG1☐-4☐ | HD | | | | | | | | | | | | | |
| | 450 | FRN355VG1☐-4☐ | LD | 1400 | | | | | | 600×2 (304×2) | | | 600×2 (304×2) | | | |
| | | FRN400VG1☐-4☐ | MD | | | | | | | | | | | | | |
| | 500 | | LD | 1600 | | | | | | 350×3 (177×3) | | | 400×3 (203×3) | | | |
| | | FRN500VG1☐-4☐ | HD | | | | | | | | | | | | | |
| | 630 | | LD | 2000 | 1400 | | | | | 500×3 (253×3) | | | 600×3 (304×3) | | | |
| | | FRN630VG1☐-4☐ | HD | | | | | | | | | | | | | |
| | 710 | | LD | 2200 | 1600 | | | | | 600×3 (304×3) | | | 500×4 (253×4) | | | |

**Note 1:** Control circuit terminals Tightening torque: 6.1 lb-in (0.7 N·m), Recommended wire size: AWG16 (1.25 mm² )

**Note 2:** A box (☐) replaces an alphabetic letter depending on the specifications.

*1 No terminal end treatment is required for connection.

*2 Use 75°C Cu wire only.

*3 It is showing the wire size for UL Open Type.
See additional material INR-SI47-1365 for UL Enclosed Type (Pack with TYPE1 kit).

* FRN45, 55VG1S-2J, FRN75, 160,200,220,355,400 VG1S-2J are not conform to C22_2No.14.
If you need it, contact your Fuji Electric representative.

## 8.3 Compliance with the Radio Waves Act (South Korea) ( )

Compliance with the Radio Waves Act (South Korea)

This product complies with the Radio Waves Act (South Korea)

Note the following when using the product in south korea

(The product is for business-use (Class A) and meets the electromagnetic compatibility requirement. The seller and the user must note the above point, and use the product in a place except for home.)

Only the following type of the products is applicable to this certification.

Type: FRN△△△VG1S-□J, FRN△△△VG1S-□E

(△: is filled with inverter output power and □: is also for what power supply voltage 2 or 4 is.)

한국 전파법 대응

본제품은 한국전파법에 적합한 제품입니다.
한국에서 사용시는 아래에 주의하여 주시길 바랍니다.
“이 기기는 업무용(A 급) 전자파 적합기기로서 판매자 또는 사용자는
이점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적
으로 합니다. 해당제품은 형식 FRN△△△VG1S-□J, FRN△△△VG1S-□E 의 제품만 대상이 됩니다.
(△는 인버터용량, □는 전압시리즈를 표시하는 숫자 2 또는 4 가 표기됩니다.)

## 8.4 Compliance with Functional Safety Standard

### 8.4.1 General

In FRENIC-VG series of inverters, opening the hardware circuit between terminals [EN1]-[PS] or between terminals [EN2]-[PS] stops the output transistor, coasting the motor to a stop. (EN1: Enable input 1, EN2: Enable input 2) This is the Safe Torque Off (STO) function prescribed in IEC/EN60204-1, Category 0 (Uncontrolled stop) and compliant with Functional Safety Standard.

Using the Safe Torque Off (STO) function eliminates the need of external safety circuit breakers while conventional inverters need those breakers to configure the Functional Safety Standard compliant safety system.

**⚠WARNING⚠**

- The output shutdown function of this inverter uses the Safe Torque Off (STO) function prescribed in IEC/EN61800-5-2 so that it does not completely shut off the power supply to the motor electrically. Depending upon applications, therefore, additional measures are necessary for safety of end-users, e.g., brake function that locks the machinery and motor terminal protection that prevents possible electrical hazard(s).
- The output shutdown function does not completely shut off the power supply to the motor electrically. Before starting wiring or maintenance jobs, therefore, be sure to disconnect the input power to the inverter and wait at least five minutes for inverters of 22 kW or below, or at least ten minutes for those of 30 kW or above.

**Otherwise, an electric shock could occur.**

Enable terminals and peripheral circuit, and internal circuit configuration

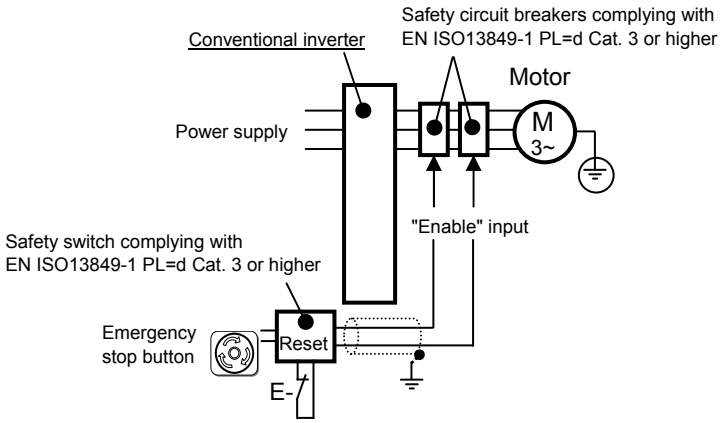
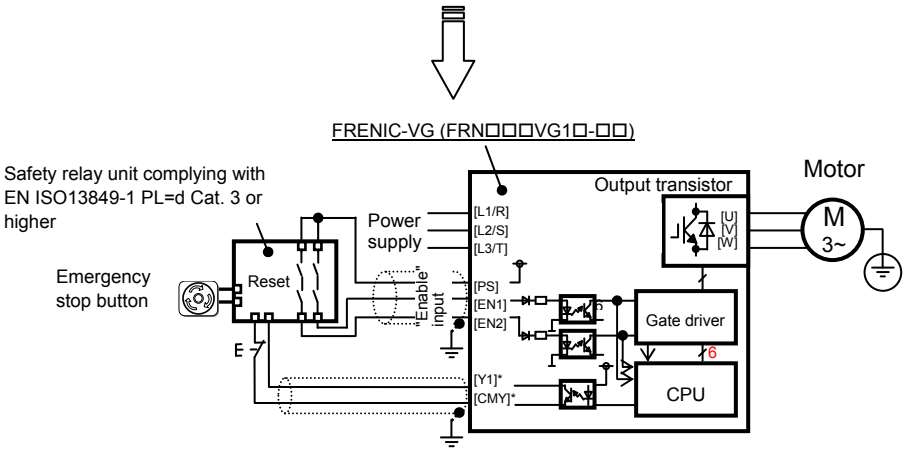



Figure 8.4-1 Conventional Inverters




*Transistor output terminals (e.g., [Y1]-[CMY], ***DECF*** (Function code data=80), Refer to Section 5.3.)

Figure 8.4-2 FRN□□□VG1□-□□

### 8.4.2 Notes for compliance to Functional Safety Standard

1) Wiring for terminals [EN1] (Enable input 1) and [EN2] (Enable input 2)

- [EN1]/[EN2] and [PS] are terminals prepared for connection of safety related wires; therefore, careful wiring should be performed to ensure that no short-circuit(s) can occur to these terminals.
- Stopping the current flowing through terminal [EN1] or [EN2] activates the safety stop function. For opening and closing the hardware circuit between terminals [EN1]/[EN2] and [PS], use safety approved components such as safety relays that comply with EN ISO13849-1 PL=d Cat. 3 or higher to ensure a complete shutoff.
- It is the responsibility of the machinery manufacturer to guarantee that a short-circuiting or other fault does not occur in wiring of external safety components between terminals [EN1]/[EN2] and [PS].

  Fault examples:
  - Terminals [EN1]/[EN2] and [PS] are short-circuited due to the wiring being caught in the door of the panel so that a current continues to flow in terminal [EN1]/[EN2] although the safety component is OFF and therefore the safety function may NOT operate.
  - The wiring is in contact with any other wire so that a current continues to flow in terminal [EN1]/[EN2] and therefore the safety function may NOT operate.
- To activate the STO function correctly, be sure to keep terminals [EN1] and [EN2] OFF for at least 50 ms.
- When inputting test pulses sent from the safety PLC to terminals [EN1] and [EN2], keep the pulse width of the OFF signal 1 ms or less.
- When using the functional safety card OPC-VG1-SAFE, keep the jumper bars mounted between terminals [EN1]/[EN2] and [PS] since those terminals cannot be used. For the Safe Torque Off (STO) function, use terminals [ST1] and [ST2] on the functional safety card.

2) Note for Safe Torque Off (STO)

- When configuring the product safety system with this Safe Torque Off (STO) function, make a risk assessment of not only the external equipment and wiring connected to terminals [EN1] and [EN2] (Enable input 1 and Enable input 2) but also the whole system including other equipment, devices and wiring against the product safety system required by the machinery manufacturer under the manufacturer's responsibility in order to confirm that the whole system conforms to the product safety system required by the machinery manufacturer.

  In addition, as preventive maintenance, the machinery manufacturer must perform periodical inspections to check that the product safety system properly functions.
- To bring the inverter into compliance with Functional Safety Standard, it is necessary to install the inverter on a control panel with the enclosure rating of IP54 or above.
- To bring the inverter into compliance with Functional Safety Standard, it is necessary to bring it into compliance with European Standards IEC/EN61800-5-1 and IEC/EN61800-3.
- This Safe Torque Off (STO) function coasts the motor to a stop. When a mechanical brake is used to stop or hold the motor for the sake of the product safety system of whole system, do not use the inverter's control signals such as output from terminal [Y]. (Using control signals does not satisfy the safety standards because of software intervention.) Use safety relay units complying with EN ISO13849-1 PL=d Cat. 3 or higher to activate mechanical brakes.
- The safety shutdown circuit between terminal [EN1] and [EN2] input sections and inverter's output shutdown section is dual-configured (redundant circuit) so that an occurrence of a single fault does not detract the Safe Torque Off (STO).

  If a single fault is detected in the safety shutdown circuit, the inverter coasts the motor to a stop even with the [EN1]-[PS] and [EN2]-[PS] states being ON, as well as outputting an alarm to external equipment. (Note that the alarm output function is not guaranteed to all of single faults. It is compliant with EN ISO13849-1 PL=d Cat. 3).
- The Safe Torque Off (STO) function does not completely shut off the power supply to the motor electrically. Before starting wiring or maintenance jobs, be sure to disconnect the input power to the inverter. For details, refer to "wiring" in the safety precautions given on page vi.
- In the case of a permanent magnet synchronous motor (PMSM), a voltage is generated on the motor terminals even during "coast to a stop" caused by the Safe Torque Off (STO) function. When handling the live parts, therefore, be sure to check that the motor is stopped and cut off the input power to the inverter beforehand.

3) Checking wiring

If wiring is changed in the initial start-up or maintenance, be sure to perform the following test with the inverter stopped.

- Turn each of terminals [EN1] and [EN2] OFF (open) and ON (short) and check on the I/O check screen of the keypad that the relevant section turns "signal ON" and "signal OFF," respectively.

### 8.4.3 Functional safety performance

Table 8.4-1 lists the safety performance values required by the Functional Safety Standard.

Table 8.4-1 Functional Safety Performance

| | | |
|---|---|---|
| Stop function | Safe Torque Off (STO) (IEC/EN61800-5-2: 2007) | |
| Response time | 60 ms or less (From input to the terminal to Safe Torque Off) | |
| Safety integrity level | SIL 2 | (IEC/EN61800-5-2:2007) |
| PFH | $2.00 \times 10^{-9}$ | (Probability of a dangerous random hardware failure per hour) (IEC/EN61800-5-2: 2007) |
| Category | 3 | (EN ISO13849-1: 2008) |
| Performance level | PL-d | (EN ISO13849-1: 2008) |
| Mean time to dangerous random hardware failure, MTTFd | 150 years | (EN ISO13849-1: 2008) |
| Hardware fault tolerance | HFT1 | (IEC/EN61800-5-2: 2007) |
| Safe failure fraction | SFF: 60% or above, Type B | (IEC/EN61800-5-2: 2007) |
| Systematic capability | SC2 | (IEC/EN61508: 2010) |
| Proof test interval | 10 years | |

- The proof test refers to a periodical test to detect safety-related failures.
- The PFH is calculated with the Siemens standard model SN29500.

### 8.4.4 Inverter output state when Safe Torque Off (STO) is activated

Turning the emergency stop button ON turns EN1 and EN2 OFF, bringing the inverter into the Safe Torque Off (STO) state.

Figure 8.4-3 Inverter Output State when the Emergency Stop Button is Turned OFF with the Inverter being Stopped shows the timing scheme to apply when the emergency stop button is turned OFF with the inverter being stopped. Input to the EN1 and EN2 comes ON, making the inverter ready to run.

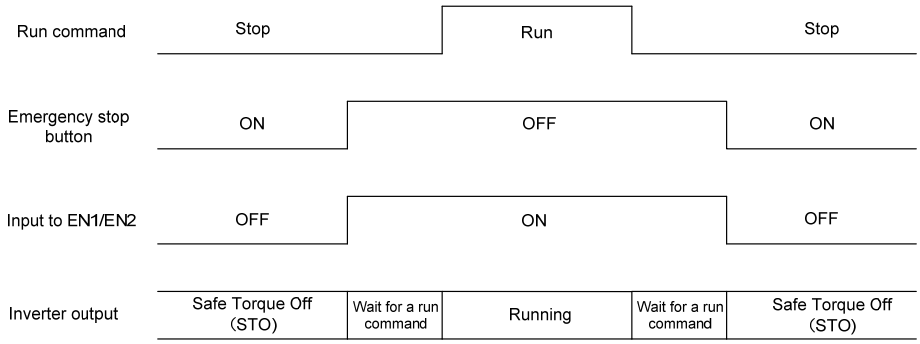



Figure 8.4-3 Inverter Output State when the Emergency Stop Button is Turned OFF with the Inverter being Stopped

Figure 8.4-4 Inverter Output State when the Emergency Stop Button is Turned ON with the Inverter Running shows the timing scheme to apply when the emergency stop button is turned ON with the inverter running. Input to the EN1 and EN2 goes OFF, bringing the inverter into the Safe Torque Off (STO) state and coasting the motor to a stop.

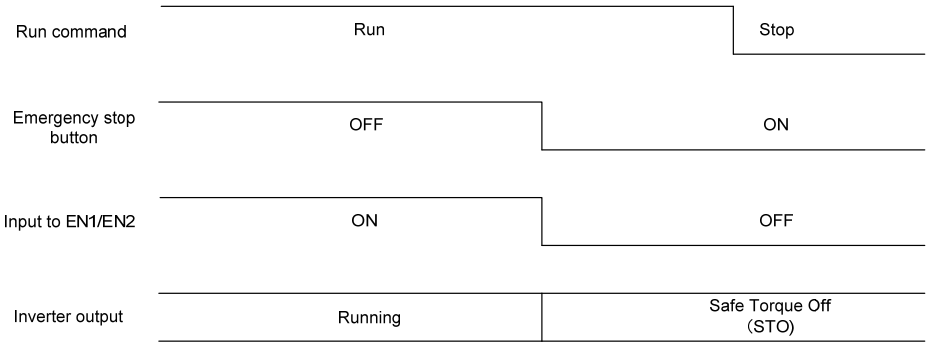



Figure 8.4-4 Inverter Output State when the Emergency Stop Button is Turned ON with the Inverter Running

### 8.4.5 ECF alarm (caused by logic discrepancy) and inverter output state

Figure 8.4-5 shows the timing scheme to apply when EN1 and EN2 inputs are not aligned so that an alarm ECF occurs.

Turning the emergency stop button ON turns EN1 and EN2 inputs OFF, which usually brings the inverter into the Safe Torque Off (STO) state. If the misalignment of the EN1 and EN2 inputs is within 50 ms, no alarm occurs; if it is more than 50 ms, the inverter interprets it as a logic discrepancy, outputting an alarm ECF The alarm can be cleared by restarting the inverter.

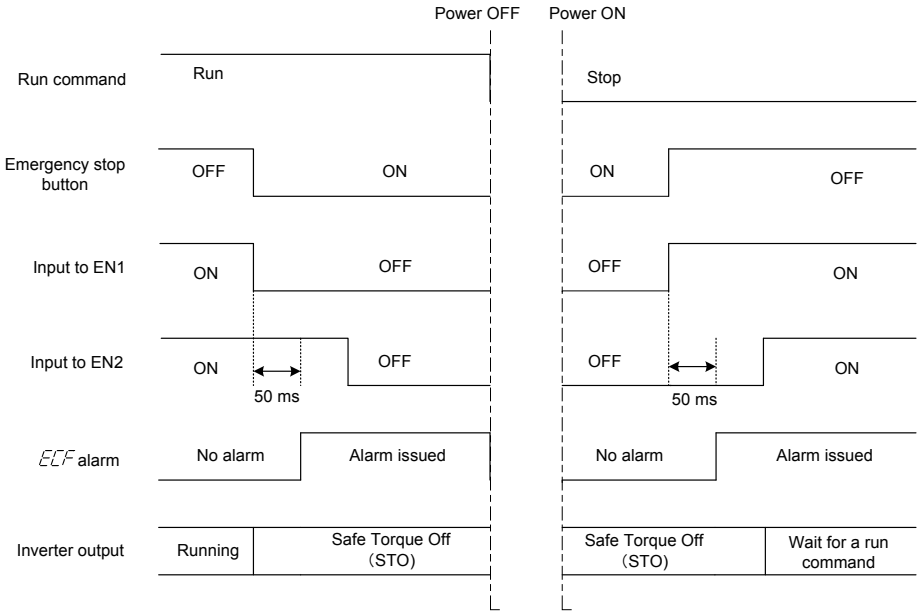


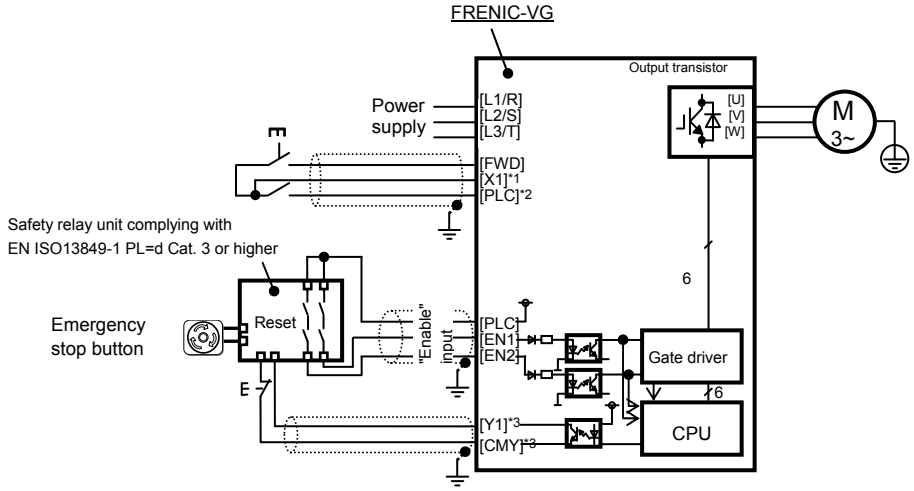

Figure 8.4-5 ECF Alarm (Caused by Logic Discrepancy) and Inverter Output State

### 8.4.6 Prevention of restarting

To prevent the inverter from restarting just by turning the emergency stop button OFF, configure the Enable input circuit as shown below. Figure 8.4-7 shows the timing scheme for prevention of restarting.

Assigning the ***HLD*** ("Enable 3-wire operation") to any digital input terminal and setting the E01 data to "6" sets up the ***HLD*** function at the [X1] terminal.

After the ***FWD*** comes ON with the ***HLD*** being ON, even turning the ***FWD*** OFF keeps the inverter running due to the ***HLD***. Turning the emergency stop button ON under the condition causes the motor to coast to a stop. After that, turning the emergency stop button OFF no longer starts the inverter to run. To run the inverter, turn the ***FWD*** ON again.




*1 Digital input terminal (e.g., [X1])

*2 If SW1 is in the SINK mode, [CM] applies; if in the SOURCE mode, [PLC] applies.

*3 Transistor output terminals (e.g., [Y1]-[CMY], ***DECF*** (Function code data=80))

Figure 8.4-6 Connection Diagram and Internal Circuit Configuration

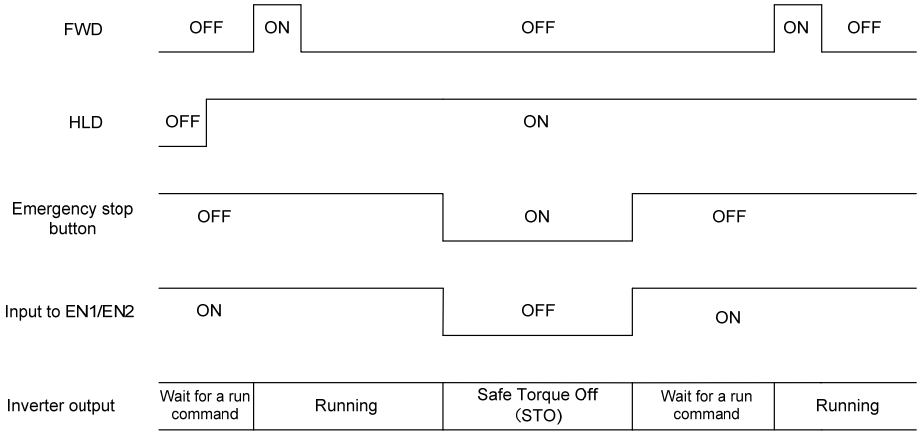



Figure 8.4-7 Prevention of Restarting

MEMO

**High Performance, Vector Control Inverter**

# FRENIC-VG

## Instruction Manual

First Edition, May 2012
Second Edition, February 2013

Fuji Electric Co., Ltd.

The purpose of this instruction manual is to provide accurate information in handling, setting up and operating of the FRENIC-VG series of inverters. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will Fuji Electric Co., Ltd. be liable for any direct or indirect damages resulting from the application of the information in this manual.

**Fuji Electric Co., Ltd.**

Gate City Ohsaki, East Tower, 11-2, Osaki 1-chome, Shinagawa-ku, Tokyo, 141-0032, Japan
Phone: +81 3 5435 7058 Fax: +81 3 5435 7420
**URL http://www.fujielectric.com/**

2013-2